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THE WESTINGHOUSE SYSTEM OF ELECTRICAL DISTRIBUTION FOR LIGHT AND POWER.

Owing to the crowded condition of our columns this week we are compelled to issue a supplement in order to give our readers a full exposition of this now splendidly complete system.

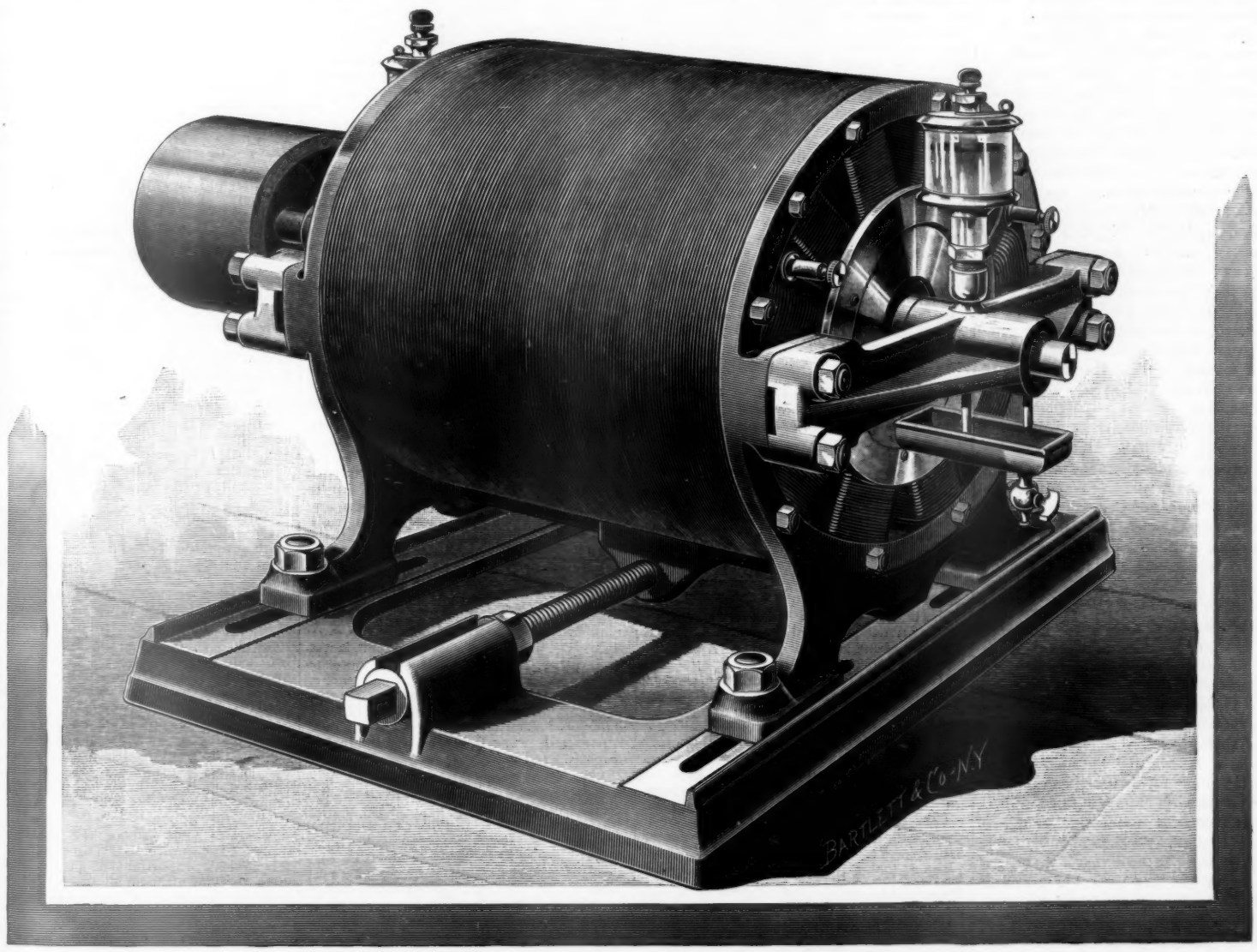
As the alternating current motor is perhaps the most interesting of the details, we present it first, illustrating it on page 1 of our regular edition.

The alternating current motor consists of a series of field magnets, wound with two sets of coils, the ends of which are connected to binding posts conveniently located for attachment to the supply circuit. These binding post form the only connection with the current, which current is taken from the regular lighting circuits, with the addition of a single return wire. This return wire makes it possible to send two alternating currents through the field of the motor at the same time, the pulsations of the two currents being similar but not simultaneous. The resultant of these two currents is that a rapidly rotating polarity is given to the field, corresponding in period to that of the current producing it.

The armature is in appearance similar to the ordinary Siemens drum armature, without the commutator. The winding is, however, much simpler, and consists of a few turns of comparatively small wire, the ends of which, instead of being carried out to a collecting ring, or any other form of sliding contact, are soldered together, forming a closed circuit having no connection with the energizing current. The alternating currents in the field induce secondary currents in the armature, and by the attraction between these and the revolving polarity of the field, rotation is produced, the rate of rotation corresponding very nearly with that of the field.

When no work is being done by the motor, the synchronism is exact, or nearly

(*Continued in Supplement.*)



THE WESTINGHOUSE ELECTRIC MOTOR.—TESLA PATENT.

ELECTRICITY VS. HORSES.

An Interesting and Important Convention of Street Car Men in Washington.

(From the ELECTRICAL REVIEW's Special Correspondent.)

The seventh annual convention of the American Street Railway Association held at Willard's Hotel, Washington, D. C., on Wednesday and Thursday, Oct. 18th and 19th, has been by far the most largely attended and important meeting yet convened under the auspices of the association.

The favorite topic discussed by the delegates from the outset, and which overshadowed all others, was the progress of electric motive power on the various systems of electric roads in operation throughout the country. The completion and very successful opening of the new Eckington and Soldier's Home Electric Railway at the Capital, on Thursday, naturally gave a great boom to the subject and the interest taken by the general public here was widespread.

During the latter part of the week great crowds of people have lined the New York Avenue from 7th street to the Boundary and gazed in astonishment at the swiftly gliding cars. At a speed trial of one mile the distance was covered in a little less than five minutes. Thursday afternoon the delegates visited, in a body, this road, at the invitation of the Thomson-Houston Company, and were very much pleased at its working. During the entire stay the delegates were royally entertained by the Washington Street Railway officials and several distinguished government officials and enjoyed themselves hugely.

At the first session Wednesday morning President Holmes delivered an address, general in character, which was remarkable for an absence of any reference to electric roads.

The regular order of business was then proceeded with, the opening paper being the "Location and Construction of Car House and Stables," which was read by Mr. C. Dinsmore Wyman, of New York, and was very complete in its scope. The report was accepted and a vote of thanks tendered its

author. Mr. Wm. J. Richardson, the secretary of the association, suggested that a reading room be established by each railroad company for the benefit of its employés, in connection with the car stables, and requested the president to state what had been done in regard to this. President Holmes stated that the association aimed to have a reading room in connection with each of the depots at a cost of $100 a month, the additional expense being paid by the employés.

A letter was then read from Mr. George Truesdale, president of the Eckington and Soldiers' Home Electric Railway Company, begging leave to announce the completion of the road which is equipped with the Thomson-Houston system, and inviting the association to call and inspect the same at the convenience of the members. A request was made that the association attend in a body in order that the officers could suitably entertain them. The invitation was accepted, and it was decided to visit the road Thursday afternoon immediately after the adjournment of the convention. Another letter from James Gunn, secretary of the Toronto (Can.) Street Railway Company, was read stating that the company was now engaged in serious litigation with the city government on the subject of block pavements, and asking the assistance of members in furnishing data regarding the permanency of cedar block pavements. Mr. Lawles, of Kansas City, and the Toledo Consolidated Street Railway Company, Toledo, Ohio, expressed their willingness of assisting the company.

Mr. Winfield Smith, of Milwaukee, then read a paper on "Street Railway Taxation," the discussion of the subject being by Messrs. McCreary, of Pittsburg; Hasbrook, of New York. The report was adopted as was also that of Mr. William D. Henry, of St. Louis, on "Conditions Necessary to the Financial Success of the Cable Power," read during the morning session.

Upon a motion of Mr. Linch a committee of seven, consisting of Messrs. Linch, Clemanshaw, Littell, Longstreet, Rugg, Ackerly and Walsh, were appointed by the chair to make nominations for officers for the ensuing year, and upon motion of Mr. Woodworth, of Rochester, the same committee were empowered to designate the place of meeting next year. Then at 9.15 P. M. the Convention adjourned until 10.30 A. M. Thursday.

THURSDAY FORENOON SESSION.

At the opening of the second day's session on Thursday, at 10.30 A. M., Mr. Hunt, president of the Washington and Georgetown Street Railroad Company, made a motion that the Committee on Mutual Fire Insurance be continued under the direction of the Executive Committee for the coming year, which was agreed to. Then the details of the trip to Mount Vernon, planned for Friday, were explained to the delegates, and a general invitation extended to members of the association, the supply men and the ladies accompanying them.

At 10.55 the discussion of electricity as a motive power was taken up. President Holmes spoke feelingly of Mr. Calvin A. Richards, of Boston, and the regret of the association in not having him present to read a paper on this most important topic. "Mr. Richards," said the president, "has no fear of lightning at all. As he has left the street railway business, he feels that it would not be proper for him to be present at this meeting, so that we have been denied the privilege of listening to his glowing terms in describing the power of electricity and lightning in moving our cars. We miss very much his presence. In the absence of Mr. Richards, we are forced now to depend for the discussion upon gentlemen who are present here."

Mr. Lawless, of Kansas City, asked to hear from the electrical lines who have recently joined the association.

Wm. Bracken, of New York, representing the Julien Electric Company, was the first speaker. He said:

"I have hesitated to become the opening speaker on this great subject because I do not profess to be an electrician, and have not the good fortune to be ranked among the gentlemen who represent your car industry here to-day. I am a Philadelphia lawyer who left the profession a year and a half ago, to take up the study of electricity. I am not a mechanic, and do not know anything about the street railway industry, but have devoted two and a half years in the capacity of an officer of the Julien Electric Company, of New York, and came here mostly as a looker-on.

"I think it a very auspicious thing that the electric traction men and the street railway men should meet to-day and exchange views. It shows that the electric traction men deem it necessary to keep with the street railway men, and I trust the latter will regard it in the same light.

"There has been a great deal of misapprehension on both sides in relation to the application of electricity as a motive power. I think electricians have led the street railway men to expect too much and that the street railway men have been too exacting with electricians. It is natural that a young and powerful industry like the development of electricity should be surrounded by a certain air of mystery. There is nothing mysterious about electricity. It is handled just in the same way that steam is handled, and when you direct your attention to it and will not be afraid of looking into it, you will be surprised to find how simple it is and how docile. I do not think electric traction is going to supersede every other method of traction, and do not think that storage battery traction is going to supersede every other method. There is a sufficient field for all and we should pull together in harmony, and by this means arrive much sooner to the desired result. No one will say that our president, Mr. Holmes, would think for a moment of exchanging his magnificent system of cable traction for any system of electrical traction to-day. It would probably be injudicious for him to do so. I cannot see any difference in starting from a central station and moving a cable which is gripped onto and moves a car. I am not here to discuss the relative merits of overhead systems and conduits, but the storage battery traction.

"About two and one-half years ago, I was in the city of Brussels, and on leaving my hotel on morning, saw a car moving along without horses or visible means of propulsion. I boarded it and upon inquiry found that it was run by accumulators, the system being that of storage batteries.

"We made arrangements with Mr. Julien to forward us a car to New York so as to apply electric traction here as well as in Europe. The car sent us was illy adapted for America, but the methods of producing storage batteries two years ago proved to be very crude. Mr. Julien sent the most improved machinery and an electrician. We went to work and fortunately were able to secure the services of keen, bright American mechanics and chemists and we soon discovered the crudeness of the work as done in Europe. We are prepared to equip a street railway line for less than it costs for horses. By the improvements made by Mr. H. G. Morris, a well-known mechanic of Philadelphia, we are able to do the work with two girls that it takes fifty men to accomplish in Brussels. The great trouble experienced with applying electricity as a motive power has been in securing men competent to handle the apparatus. It is comparatively easy to secure men for cable roads; but as we are engaged in a comparatively unknown art, of course, it is difficult at first to find competent men, but we have made such advancement that our shop at Camden, N. J., is 2,500 batteries behind in orders. We light a large number of the Pullman cars, the vestibule cars on the Pennsylvania road and the entire works at Waltham, Mass. All these are run by the Julien storage battery. This shows the progress in two years made in this comparatively unknown art. We put a car on the Fourth and Madison Avenue Line on the 17th of last month. This car has a body of 18 feet and capacity of carrying 75 people. It has been running constantly since and has not stopped traffic once or experienced an accident of any kind."

Mr. Love, of the Electrical Company, of Philadelphia, endeavored to speak at length on the subject of the conduit as applied in electric roads. He did not enter in detail, as his time was busily occupied answering questions of delegates that were not germane to the question. Before he had time to explain the objects and benefits of the inventions of his company, his time expired.

Mr. Thomas C. Barr, of Philadelphia, President of the People's Passenger Railway Co., and the Lombard and South Street Passenger Railway Company, was the next speaker. "The storage battery system," he said, "was tried experimentally over our road for at least two months, running 16 miles a day in the afternoon, using 22 foot cars, the aggregate weight being 14,800 pounds, of which 4,800 pounds was the weight of the batteries. These batteries were those of the Accumulator company and operated by the Electric Power Company of America.

"As we anticipated reproducing electricity as a motive power it was necessary to relay lines which were constructed with cross ties 2½ feet apart. The car would seat 34 passengers and would carry when crowded 125 people. When thus loaded the average weight would be 30,000 pounds. A two months trial was very satisfactory as the car ran smoothly, steadily and nicely. It moved off gently from a full stop without any jerk and was taken off only by reason of the fact that a large sewer was constructed through the center of our street causing us to run a siding, and we were afraid the weight of the car would interfere with the work. The cost of the car could not be figured up because the power was lost at the high figure.

"It took 3½ hours to charge the battery to run the car 16 miles, costing 15 cents. Taking 18 miles as a day's work of a car with 18 hours work for our men, it would make the cost of operating the car a day $9, including the wages of the men and the cost of charging batteries. We found a high rate of speed could be maintained, and yet not be noticed by passengers or those walking on the street. The car was of course operated on a level road with but four curves. The same car was operated in the works of the Electrical Car company with one charge for a distance of 63 miles, which was very satisfactory. In both cases the experiment was perfectly satisfactory so far as the operation of the cars was concerned, and it was necessary to have each car separate and independent of the other to get the best results. The only difficulty at present is the actual cost of the cars with the storage batteries as well as the cost of reconstructing the road, but I have no doubt this system will in a very short time be brought down to such a point that the car can be operated by batteries much less in weight at a great saving of expense."

Mr. Cobb, of the West End Line in Boston, was next called on to speak, but he declined stating that he was not a delegate and therefore not entitled to speak, and having no memoranda did not wish to speak from hear-say.

Mr. F. J. Sprague, of the Sprague Electric Railway and Motor Company, stated that the conduit, overhead and storage systems all had their good points, and each has its way of working to attain the effect. One year ago there was not an electric system in this country except one in Boston. On the second day of last February the Richmond road was started, and is the largest electric railway in the country, having twelve miles of tracks. It is operated by overhead wires, and not a share of the stock is owned by the Sprague Company. The grades on this road are from six to eight feet and the curves from 26 to 27 feet. Since starting, the cars have run five hundred thousand miles, and a million people have been carried. At times the cars have run 8,000 miles without going in the shed, in fact they have been housed in the street under the canopy of heaven for some months. They were built for the work of seven and a half horse power, but have frequently been compelled to do the work of twelve horse-power. A year ago it was not possible to design a street car motor to meet all the exigencies that might arise. There was not sufficient knowledge of electrical engineering and car builders did not understand electricity. There was not a car constructed, properly braced and the brakes properly fixed in.

"We spent $150,000 in Richmond, and have received in the last year 28 or 29 contracts. We have no interest in any one of these roads, they are all *bona fide* contracts, either paid for in cash or arrangements made to pay. From 90 to 96 per cent. of the cars are in constant service, working 20 to 21 hours a day. A lighting company furnishes the power to the Richmond cars for $1.60 a day. In Harrisburg we have 50 cars running on lines constructed by our company. There has been objection to overhead wires on account of looks. One road in Boston cost five times as much as the Richmond roads. It is being put up in the best style known. It will stand a strain of 1,400 pounds. The central station is so constructed as to be able to take in all roads in the city. Three miles of this road will be built by the conduit system under the Bentley-Knight system. This winter will furnish the crucial test of electric roads in the Northern States. We will see what effect the hard winter weather will have on the roads. We have roads in Boston, Akron and Cleveland. Next spring will be known what the electric roads are. The southern climate it is as well in winter as summer."

Mr. Sprague was asked if his company owned any portion of these roads. He said "Not a cent." His company was composed of himself, the President of the Edison Company, and the other member is the most prominent banker in this country. "As I have said we have no interest in them and don't want any. We employ the best men and hold them responsible for their work. I think we have harnessed lightning so as to avoid any trouble from that source. All that can be seen when lightning strikes a wire is a click and a spark—the passengers know nothing of it. Sometimes it may burn out the motor. I would run a car in the heaviest thunder storm in the United States and feel safe from danger."

Mr. Marson, of New York, stated that he was in Richmond, September 12th, and that the cars run from fifteen minutes to an hour and a half apart.

Mr. Sprague replied he would not be responsible for anything that happens on the Richmond road for no attention was paid to the cars. They were allowed to remain in the street and become covered with slime and dirt. Several delegates asked information regarding the danger to passengers, etc., to all of which Mr. Sprague replied that they were as safe as the horse car.

Mr. G. W. Mansfield, of the Thomson-Houston Company, said:

"The successful application of electricity to the propulsion of street cars can only be attained by the most hearty co-operation of the electricians and the railway men. The electricians must look to the practical and experienced railway managers for a full and complete knowledge of the obstacles to be overcome and the results necessary to be attained, and the business man must be informed fully and freely of the plans of the engineer and of the practical result of his study and research that he may intelligently criticise, advise, correct and, in the end, accept or reject.

"Being fully impressed with the truth of this statement, as I am called upon as a representative of the Thomson-Houston Electric Company, I desire to explain some of the details of our apparatus, the reasons for adopting the various devices and the practical results which we have achieved.

"As to the truck! We think that the truck should be entirely independent of the car body. The advantages of this arrangement are manifold. At the outset of our work we found that the best approved system for placing motors under the car was to clasp the axle with one end of the motor and provide a flexible support from the car body for the other end. We were unable to give our approval to this method and we designed a flexible support on the truck itself, which left the motor entirely independent of the oscillations of the car bodies and still gave us the slight play necessary to lighten the strain in starting the car. All of our trucks have been constructed on this principle since our first car was started at Crescent Beach on the Fourth of last July. We are pleased to observe that other electric companies have recently adopted this system as it proves the correctness of our views.

"Our motors are provided with self-oiling bearings and self feeding brushes so that they work automatically. The brushes are set at right angles to the face of the commutator, thus avoiding the troubles which arise with tangential brushes. The laminations of sheet copper which make up the brush are placed at right angles to the direction of rotation or edgewise, so that it is impossible for them to become bent. They wear very gradually and require no attention until they are actually worn out, when they can be very easily and quickly replaced. Our practical experience shows that no other form of brush will give such excellent results; we have had no trouble with brushes on any of our motors. Our motors are constructed with but one commutator using but one pair of brushes, and this with our automatic feeding brush holder greatly simplifies the mechanism and reduces the attention required to a minimum. The electrical and mechanical proportions of our motors are such that no adjustment of the brushes is required for change of load, and sparking is entirely obviated.

"We have from the first, with perfect success, used fibre gearing to deaden the noise, and we are glad to see that other companies are now adopting this obvious means of accomplishing so desirable a result.

"The question of the use of an outside rheostat to control the current in stopping and starting the car was one which received very careful consideration. Without going into the scientific points, we will simply say that we deemed the use of such rheostat much safer, more reliable, more economical as regards repairs, and in every respect preferable to the use of the field coils for a similar purpose. The rheostat is only used in stopping and starting the car, or say for not over one-tenth of the time that the car is running; it is substantially constructed and is very durable. The principal objection urged is that the bearing of the rheostat involves a loss or waste of power. This is

true, but the waste is slight, whereas the use of field coils involves the danger of burning out of these coils and a few such disasters would much more than counterbalance the slight waste of current in rheostat.

"In discussing our overhead system I have arranged everything under the three headings: Systems, Methods and Details.

"I divide Systems into:

"1. One wire per track, using track for return.

"2. Two wires per track, one as the outgo the other for the return.

"Methods I divide into:

"1. Bracket arm method, poles on side of street.

"2. Cross suspension method, poles on either side of street.

"3. Bracket arm method, poles in center of street.

"Details of Methods I subdivide into:

"1. Poles.

"2. Conductors or feeders.

"3. Supporting devices.

"4. Switch and curve devices.

"This arrangement is made to simplify and to illustrate the fact that there are a great many things that we have to carefully consider. I shall not, however, rigidly hold myself to the points in their chronological order.

"In considering the systems each has certain advantages. The one, however, possessing the majority will be the one most generally adopted. Taking experience as our teacher, we are taught that the single wire system is this one. A great deal, of course, depends upon local conditions, but so far we feel our opinion in this matter is correct.

"In either case the methods are almost identical, varying only by introducing the necessary insulation between the two wires. My general remarks upon the methods employed can therefore be applied to both systems. Obviously, the local conditions govern the question of methods. Am I to build a line for a road located upon the side of the street or in the centre, for a single track or for a double track. Each of these we have already gone into extensively and carefully, and all can be seen practically worked out on the Eckington and Soldiers' Home Railway in this city. In describing our details it might therefore be as well to briefly and accurately mention the details of this road. The poles on the portion of the line which runs through New York avenue, a very broad street, are located in the centre between the tracks. They are made of sections of iron piping varying from 6" to 3½", and are rigidly connected together. Twenty one feet from the ground cross arms are extended out to the centre of the tracks.

"Every other pole is extended upward seven feet, from the top of which extension is placed a cluster of ten lights. Each of 32 c. p. Five of these are white and the balance are red. The latter are automatically thrown in if one of these white lights should fail. The red is therefore an index to the lineman that the cluster needs attention. The ornamentation of these poles is simple. Evidently the only limitation in this direction is the cost. We consider this method is to be more generally adopted if it is correct in principle and the objections so generally raised are based upon some curious predilection or prejudice. The conductor is suspended. The posts used for the bracket method are of planed 9×9 tapered chestnut. The arm consists of a piece of 2" gas pipe supported by a neat iron bracket bolted to the post. The posts used for the cross suspension method are of the same character, and as the method is so well understood I shall not enter upon it here. The conductor is supported with our regular cone insulators and ears. These may vary somewhat according to the conditions to be met. The cone insulator as its name implies, is conical in shape. It is made of wood with a protecting hood of paper and canvas, preventing the same from getting wet with resultant loss of current from leakage. It is provided with two hooks, one at the apex for hooking into the arm or cross wire, the other at the under side for hooking the ear to. The ear for straight work is soldered upon the upper side of the conductor and then hooked on to the cone insulator. This leaves a perfectly smooth surface on the under side for the trolley wheels. For curve and switch work the ear is arched so that the strains are all in the same place. This obviates all distortion and canting of the supports. Insulation is also introduced on this ear directly at the point of support. The frogs for switches and turnouts are small, light and absolute in their action. For fear of wearying you, I will close this description and invite your attention to our details on exhibition. We ordinarily use a single conductor, stout and substantial in character, believing that some rigidity is advisable, and that a multiplicity of wires is objectionable and to be avoided. Whenever the roads are of such magnitude that such a wire is not of sufficient capacity, we supplement the same with feeders.

"In conclusion, we request the co-operation of you gentlemen of the Street Railway Association in the improvement of the electric method of propelling street cars. We invite your careful inspection of our system on the Eckington and Soldiers' Home Road, in this city. We want you to criticise, to condemn what you find faulty, and to award any meed of praise to which you may find us entitled. We want to know wherein we are deficient that we may add; wherein we are wrong, that we may correct; wherein we are right, that we may go ahead.

Mr. Robert W. Blackwell, of the Bentley-Knight Electric Railway Company, New York, spoke as follows:

"When I had the pleasure of speaking to you at Philadelphia last year I said many things about what we proposed to do during the coming year. We have got a road running on the conduit system at Allegheny City, Pa. Last December two cars were started, and February 15th, four cars were running. About six weeks ago two additional cars were put on, making six in all. The work required of the motive power is the heaviest of its kind in the world. We are using the heaviest motors in the country, and have 30 nominal horse power on every car. The road has been swamped by freshets and had other difficulties of like nature to contend with, but during the entire time there has never been a stoppage from a defect in the electrical system. The specialty of the Bentley-Knight system is the conduit system. We have laid the only conduit systems. We build both overhead and underground roads and have had to contend with every difficulty that it is possible, and I think it is fair to say that we have met them all, and the road at Allegheny is a practical solution of the city railway service. We are now building a three mile section for the West End Street Railway Company of Boston. The road is laid through some of the finest streets of the city, and upon this road both the overhead and conduit and overhead systems will recieve a crucial test and from the results of the trial the future of electrical motive power can be decided.

"Upon a thirty day trial made by the Superintendent of the Allegheny City Road, the result was as follows: Daily mileage per car 72 miles, running on an average five cars per day. The receipts for the last four days were as follows: September 23d, $201; September 24th, $116; September 25th, $151; September 26th, $153. During the four days the average mileage per car per day was 85 miles per car. During the coming winter a thorough test of the working of the conduit system will be made at Boston, New York and Allegheny, the difficulties being such as to meet the requirements of every road in the United States.

"In regard to overhead wires, we do not object to them. The cost of such a system would not exceed for a double track route $2,500 or $3,000 per mile, while the underground system would cost, at least, $25,000 per mile, single track. The best of care must be taken of the mechanical part of the road or the running of the system will end in a dismal failure."

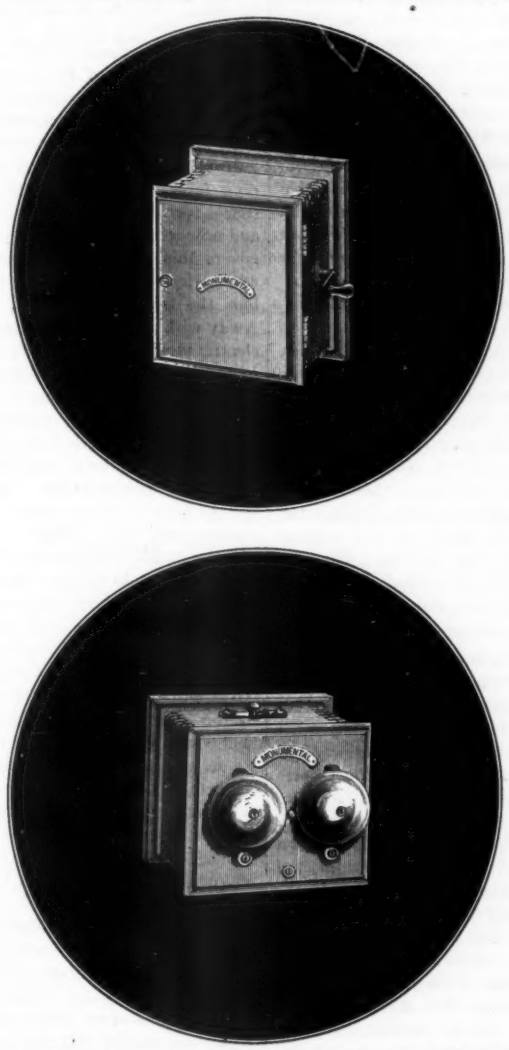
THURSDAY EVENING'S SESSION.

Shortly after two o'clock business was re-opened, and the question of rights of corporations to erect poles in public streets was discussed.

Mr. Henry A. Sage, of Easton, Pa., wanted to know something about electricity, but not from electric motor men. He desired his information from railroad men. A general discussion ensued on this question in which only the tramway men took part, and their opinion was that the fitting out of an electric plant was too costly for small roads.

The following officers were elected for the ensuing year:

President, George B. Kerper, of Cincinnati.



NEW FORMS OF MAGNETO BELLS, MANUFACTURED BY THE VIADUCT COMPANY, BALTIMORE.

First vice-president, Jesse Metcalf, Providence, R. I.; second vice-president, Henry Hurt, of Washington; third vice-president, W. H. Martin, San Francisco.

Secretary, W. J. Richardson.

Executive Committee, Charles B. Holmes, Chicago; John Scullin, St. Louis; James H. Johnson, Savannah, Ga.; Henry A. Sage, Easton, Pa.; Edward J. Lawless, Kansas City.

Minneapolis was selected for the next place of meeting, and at 4.25 the convention adjourned *sine die*.

The banquet in the evening was a great success. To-day the delegates visited Mount Vernon. E. J. REDMOND.

Washington, D. C., Oct. 19.

New Magneto Bell.

The Viaduct Manfacturing Company, of Baltimore, has recently introduced a magneto bell, which we illustrate in this issue. The new bell is called the "Monumental," and is a departure on the part of the Viaduct Company intended to meet the demand for a cheap and effective magneto bell to take the place of battery vibrating bells for various uses. These bells will probably meet with wide circulation, as they will last for years without any cost for renewals.

Oxford, O.—The Oxford Electric Company, of Oxford. Capital, $20,000. Geo. C. Munns and others, incorporators.

Kansas City, Kan.—The Kansas City Electric Company, Kansas City. Capital $100,000. I. D. Wilson and others, incorporators.

Easthampton, Mass.—The Peoples Electric Company, of Easthampton. Capital, $5,000. Chas. W. Smith and others, incorporators.

Chicago, Ill.—The Cumberland River Iron and Manufacturing Company, at Chicago. Capital stock, $1,000,000. Incorporators, William A. Gardner, Frank B. Dyche, and Frank F. Reed.

Covington, Ky.—The American Wire Nail Company, Covington, has increased their capital from $100,000 to $300,000, and will add a rod mill of 100 tons capacity, and a wire mill of 75 tons capacity.

Milwaukee, Wis.—The Edison Illuminating and Power Company, of Milwaukee. Capital, $100,000. The incorporators are Herman Nunnemacher, Charles Pfister, Rudolph Nunnemacher, and Robert Nunnemacher.

Camden, N. J.—The Merchantville Gas Light and Fuel Company. Capital, $30,000; $1,000 paid in. The incorporators are Edward W. Delacroix, Joseph Cooper, Eldridge G. Kemble, Charles S. Kemble, and Edward Kellogg.

Buena Vista, Cal.—Certificate of incorporation of the Buena Vista Electric Light Company, with $15,500 capital stock. H. H. Daniels, John Tiptore, and G. S. Wood are named as directors for the first year, and Buena Vista as principal place of business.

Camden, N. J.—The United States Gas and Fuel Company. Capital stock, $350,000, full paid in. The incorporators are George K. Cummings, Henry D. Hughes, Edward Shallow, Joshua Hunt, Robert H. Hepburn, David Hunt, and George E. Webb.

Chicago, Ill.—The Central Electric Light Company, at Chicago. Capital stock, $50,000, to furnish light, heat and power produced by electricity and otherwise. Incorporators, R. T. McDonald, F. H. Cooper, Henry Siegel, W. J. Buckley, and George Driggs.

Mansfield, O.—The Richland Electric Light and Power Company, with a capital stock of $15,000 in shares of $100 each. John T. Sill, Huntington Brown, S. G. Cummings, John F. Gay, and S. A. Ringle are the incorporators. The company will adopt the Westinghouse system of incandescent lighting.

Omaha, Neb.—The South Omaha Electric Light, Heat and Power Company was incorporated with a capital stock of $25,000. J. F. Boyd, J. A. Doe, Hy. H. Meday, incorporators, with J. F. Boyd, president, and J. A. Doe, secretary. Arrangements have been completed for the erection of an electric light station of 35 arc lights.

Duluth, Minn—White Iron Lake Iron and Water Company. The company is organized for the purpose of smelting, reducing, refining and working iron ores and other metals. The members of the corporation are: Frank W. Eaton, Richard Fagan, Henry H. Bell, Edgar Brown, of Duluth; Henry M. Loud, of Oscoda, Mich.; George L. Walker, of Detroit; and David I. Fox and Charles S. Brown, of Flint, Michigan. Frank W. Eaton, president; Edgar Brown, vice-president; and H. H. Bell, treasurer and secretary. Office at Duluth.

Portland, Me.—The Robinson-Foster Electric Railway Motor Company, at Portland. Capital stock, $1,000,000; amount paid in, $400; par value of shares, $10. The stockholders are Orlando A. Foster and Matthew H. Robinson, Boston, Mass.; Thomas N. Covell and Stephen Burger, Salem, Mass. Thomas N. Covell is president; Stephen Burger, treasurer, and the above-named stockholders are directors. The purposes of the corporation are manufacturing machinery, dynamos, and all other electrical appliances for electric railways.

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The address by Mr. C. J. H. Woodbury, of Boston, on "Electric Welding," appears in another part of this issue. In addition a valuable table of tests was submitted which we shall publish next week.

How to utilize the powers of Niagara is still a question that meets with much attention. If the water wheel men will harness the power the electrical fraternity can be depended upon to find means to transmit and distribute it.

The street railway men are becoming more and more interested in electric traction. Our special report of their meeting in Washington last week is instructive as showing the drift of the practical street car men in the larger cities, away from horses and cables, towards electricity.

While Edison and others in this country are attempting to develop electricity from heat without a dynamo, in Europe the thermopile is not neglected. Some tests recently published regarding the Raub pile, show that using 50 couples giving 3 volts and 40 amperes, there were consumed 33 cubic feet of gas per hour. This is equal to about 200 feet per electrical horse-power per hour, or some five or six times as much as a combined gas engine and dynamo require, often, however, the hot gases leaving the thermopile could be used for heating or other purposes, so the cost to be charged to the current would not be so great.

The hot steam pipes of New York City are destroying the cables in the conduits for electric wires. As we must have the service of the wires, and as they must, of course, all be buried, why not run the steam pipes overhead? Then on cold nights the homeless wanderers in the metropolis could perch on these warm cylinders and defy wintry blasts. What a beautiful sight it would be to see, on a bright, crisp moonlight night, a row of tramps roosting on warm steam pipes extending from the Battery to Central Park, and what a feather it would be in the cap of our own Board of Electrical Control to successfully carry out this benevolent project! It might be necessary to locate Commissioner Hess at the Park end of the line, Commissioner Gibbens at the Battery, and Commissioner Moss at Wallack's theatre, to see that proper decorum was observed all along the line, but these public spirited gentlemen would no doubt enthusiastically respond to this philanthropic demand.

The REVIEW covers the field this week. In addition to eleven pages of reading matter, a handsomely illustrated eight-page supplement is issued. And, better than all, everything inside its covers will be found to be interesting and instructive, and typographically excellent.

Dr. Lawrence, an English physician, has been carrying on some very interesting experiments with regard to reducing the thickness of the albumen of the eye, by passing light currents of electricity through the ball to reduce it to fluid. He tried it by heating in water the white of an egg, and, after having caused it to set, reliquified it with great success by passing currents through it.

Membership application blanks are being sent out by Mr. A. V. Garratt, secretary and treasurer of the National Electric Light Association, 16 East 23d street, New York. The local electric light and power men of the United States should all become members of this progressive organization. The annual dues are but $20, and there is not a company furnishing light or power but what would be benefited more than ten-fold by membership in this Association.

We learn from the Paris *Le Pays* that Commissionaire d'Electricité Hewhitt has been made mayor of the State of New York because of a telling address he made recently condemning as refined cruelty the employment of electricity in capital punishment; demonstrating his charges by experiments on brutes who whined and howled dismally from pain; the blood at times starting from their pores. Such is fame!

Doubtless in the French encyclopædias of the year 2900, we may read: "Absolom Hewhitt, of New Jarse, North America, Sachem [English for Indian Chief], Tammany tribe North American Indians, renounced his Indian allegiance and adopted Christianity and (the) Reform [slang for Faith Cure.] He flourished about 1323 A. D., some authorities make it 1323 B. C."

The tanks in the fine fish exhibition made by the U. S. Fish Commissioner at the American Institute Fair, have incandescent lights dipped into the water. The other night a big German Carp, seeing what he took for a somewhat obese glow worm monkeying above his head, made a jump for it with the idea of taking it in with what the daily press would call a "fell swoop." The swoop felled all right, but the fell didn't swoop as was expected; the little globe slipping from his mouth and bobbing about on its wires with tantalizing whirr! Ruminating for a moment over this absurd conduct on the part of the glow worms, Mr. Carp made one more effort, this time getting the little globe into his mouth and being unable to swallow or let go was about being transformed into fried carp, so hot was the lamp when it was jerked out of his mouth. He will size up glow worms more carefully hereafter.

So-called magnetic and electrical "cure-alls" are advertised and puffed on all sides, and vended in nearly every apothecary's shop. It is safe to say all of them are frauds, rank, unmitigated, not to say expensive. Temporary relief can be had from electricity for various ills, in the hands of skilled physicians, notably rheumatism and kindred ills, but as to quick and absolute cures a potato carried in the pocket or a cat's tooth worn around the neck will prove quite as potent. Mr. Edison said to us once regarding an electrical contrivance with his name attached, that was being sold as a "cure-all" "I sold that with the distinct understanding they were not to promise more than that it would give temporary relief in rheumatism." It is time the electrical fraternity took some steps to denounce the venders of these frauds, though we dare not prophecy even this would prevent their continued purchase or scare away the fools; for it is a peculiarity of the fool that he returns to his folly.

THE ELECTRIC MOTOR OUT OF THE WOODS.

Through all the vicissitudes of the world's history wood has been a beneficent factor in the make-up of mankind's achievements. Troy was conquered by the pacifying eye of a wooden animal. Wooden guns for ages were the acme of man's ingenuity. Wooden ships majestically rode the waves. Wooden railways stepped forward. The Yankee's famous whittling of extra points on a cargo of shoe-pegs and the sale thereof for genuine oats, was not behind the times, to say nothing of wooden nutmegs. Wooden Indians are still the masterstroke of the carpenters art. Wooden men abound. But another achievement in the fibrous line is still to be heralded. The following announcement from the facile pen of that wondrous being, the reporter, appears in a late issue of the *Pittsburgh Commercial Gazette:*

Accidents on the St. Clair Railway to be Stopped at Once.

The motors machinery of the St. Clair Electric Railway Company is being reconstructed. Heretofore the motors have been made out of wood and have proved very unsatisfactory, as they were constantly getting out of repair. The company then determined to throw out all the old motors and construct new ones which are made entirely of iron.

Now the shame of it all is that electrical engineers have been so long puzzling their brains over intricate constructions in iron, brass and copper, castings which would not "draw," or shrinkage would break, chipping faces inaccessible to the cold chisel, spaces for wire and margins for insulation; and now comes an acute reporter and discovers this is all wrong, unnecessary and nonsensical. With one fell swoop his axe lops the trunk of absurdity at its roots. Away with iron, brass and copper, since the electric motor can be made of wood, and no tools required but a hatchet and a hand-saw. Where now are the laurels of the men who fashioned the laws of conductivity, resistance, current strength, lines of force, etc.? They have had their labor for their pains. Hail to the wooden motor. Every man can now be his own motor maker, and if he be a wooden man, all the better.

But will this not make a corner in lumber? What a vast field for speculation! If wood can thus be so deftly substituted for iron and other metals, why continue to use them? Insulation is a thing of the past. Armature cores are safe now. No eddy currents to struggle with; no lines of force from iron to iron. Goodness! what an edifying prospect compared to the present turmoil. Still we get our polarity, and it can be hickory, oak, etc., according to which way the motor is to rotate, or the kind of current wanted. The latter may be stained walnut if a récherché effect is desired. The demand will compel the "nigger in the woodpile" to come out and 'fess up.

Not the least of the benefit will be the character imparted the current by the generating material. Rosewood will give a ponderousness to the current suitable for pile-driving motors and legal executions. Bird's eye maple will spangle the current with beautiful spots and curls, especially fitted for treating pathologically cases of D. T., where the patient sees nothing but snakes. And so on *ad infinitum;* but we need not expand—our readers can see it all at a glance.

There is still an element of sadness in this latest reportorial discovery. With all these expected inroads, and the modern revival of the wooden age, when we have wooden electric railways, wooden motors, and wooden men to design and operate them, what will become of the occupations of the tin soldier and the man with the cast iron jaw? Poor things! But, such is life. The wooden electric motor must go onward in its wonderful rotation and evolution, and time vindicates everything—even to placing a humble reporter on the throne of scientific triumph, a leader of all the ologists of the day. Salve!

The report of the Street Railway Association will be found of interest, and the time devoted to the discussion of electric power shows the street car men of the country to be wide-awake and progressive. We predict that by another year they will find much more to interest them in electricity.

OUR CHICAGO LETTER.

(Special Correspondence.)

The City Council Chamber on Monday evening was enlivened by the presence of some 50 druggists who came to witness the proceedings on the question of telephone ordinances. The minority champion moved that his ordinance be sent back to the law department for an opinion. A motion to place the whole matter on file, as well as the previous motion, was objected to because it would be considered a backing down on the part of the Council. The alderman—Hamline—thought it cowardly to shirk, and it was time something was done. The suggestion that the ordinance could not be enforced, he would answer by saying that the company was now operating without any ordinance. It could not lay a wire or put in an instrument without the consent of the authorities.

The motion to refer back the minority report ordinance was tabled by a vote of 25 to 19.

Alderman Dixon then moved to reconsider the vote by which the minority report was substituted for the majority, which was carried by a vote of 35 to 9.

That effectually shelved the minority, and the majority ordinance was now squarely before the Council.

The Mayor asked Alderman Ernst—the champion of the majority ordinance—if the corporation counsel had not informed the committee that the ordinance could not be enforced if the company refused to accept it. The alderman had not been so informed, but Badenoch and Manierre so understood it. The Mayor said he asked for information, because if the law was not enforced after its enactment the press would likely hold him responsible. He was in favor of cheap telephone service, but he wanted the Council to understand the situation thoroughly, and must not be considered as opposing the ordinance.

Cullerton wanted the corporation counsel to pass upon its legality. Wheelan favored reference, also, while Campbell said there was no use in passing an ordinance that would not stick. Hamline thought the passage of the ordinance would give the city a basis for negotiation with the company or basis of action against it. After some further remarks by several aldermen, Alderman Dixon closed the discussion, saying:

"The telephone company admits that it has no ordinance and no standing in the city by introducing into this Council surreptitiously the ordinance which was reported by the minority last Monday night and happily rejected this evening. The company therefore puts itself in the position of begging for a franchise. We will meet it half way by passing the ordinance reported by Alderman Ernst. Let us have no further fooling with this matter. Let us put this monopoly on the defensive here now. The ordinance is generous to the company—more generous than it ought to be. But we can't well help ourselves. Let us give the Mayor this ordinance to present to the corporation. If the monopoly rejects it the public may be heard from in the matter."

The lobby loudly applauded Dixon, Hamline and the Mayor during their observations. Dixon ended by moving to lay Cullerton's motion to refer on the table. The motion was carried by a vote of 23 to 21.

This was considered a test vote, and the ordinance was immediately put upon its passage as a whole, and carried with only four dissenting votes.

The ordinance provides that the company shall not charge for the use of each telephone connected with its exchange a greater sum than ninety-five ($95) dollars for the first year and not more than eighty five ($85) dollars for each subsequent year such telephone shall be used; provided said company shall contract for three years' service with any one party at the rate of seventy-five ($75) dollars per annum, payable annually, and provided the said company shall connect its wires with the Mayor's office, Department of Public Works, Fire Department, Police Department, Building Department, City Collector's office, City Clerk's office, Health Department and Law Department, and place and keep one telephone in each of said places, free of charge to the city, so that said telephones may be used in connection with all wires under control of said company connected with its said exchange in the City of Chicago; and provided, said company shall rent to the City of Chicago

telephones for the sole use of the police and fire alarm system of the City of Chicago at an annual rental of not to exceed five ($5) dollars per annum for each telephone outfit.

It provides also that all lines, except those going through the tunnels, within the following boundaries: Commencing at the intersection of the lake and North avenue, thence west on North avenue to Wells street, south on Wells street to Lake street, west on Lake street to Ashland avenue, south on Ashland avenue to Sixteenth street, east on Sixteenth street to Butterfield street, south on Butterfield street to Thirty-first street, east on Thirty-first street to the lake, shall be placed in underground conduits, which conduits shall be built at the rate of two miles per annum from and after the passage of this ordinance, and shall be constructed under the supervision of the Commissioner of Public Works.

One of the morning dailies insinuated that the Mayor was interested in telephone matters, and endeavored to show that his Honor was trying to shelve the ordinance. Mayor Roche was justly indignant and challenges any man to produce proof of his having any interest in any telephone company or corporation whatever.

The statement was manufactured out of the fact that a prisoner's friends wanted that individual properly "booked," that he might have bail, and the Mayor was called out of the meeting to see that the booking was done. That was all.

President Phillips, of the Chicago Telephone Company, had a long interview with the Mayor, and the latter gentleman said that he would like to have the whole matter submitted to the Supreme Court, on a case made up by the company and the city. The newspapers are suffering between sorrow and anger because the telephone officials talk so little. All that President Phillips would say was: "It would be discourteous for me to criticise the provisions of a bill which has not yet become a law. I have no reason to suppose that Mayor Roche will sign it. He may do so, and again he may send the Council a communication suggesting amendments or alterations. Until the ordinance is signed by Mayor Roche I have nothing to say." And: "You must excuse me for declining to answer that question or any other bearing on the subject."

Superintendent Wilson and other officials were equally reticent.

And the Mayor: "The opinion of our Law Department is that the ordinance is invalid, and I will not sign it," he said. "Neither will I veto it. It is simply a question as to whether the telephone company will accept the ordinance. It doesn't seem as though they would, when the new ordinance compels them to charge less by $50 a year on three year contracts than they are now getting. The company has 30 days in which to accept the new ordinance."

The *Tribune*, which has been much exercised on the question, advises the company to throw off the suspicion that its officers would prefer to obtain more favorable legislation by corrupt means. "Take your medicine like little men," is the burden of its song.

The following table has figured in the investigation and may be of interest in this connection:

CITY.	Population, '80	TELEPHONE CHARGE PER ANNUM.	TAX PAID TO CITY.	OTHER TAX.
Albany, N. Y.	110,000	$48 to $60		
Burlington, Vt.	12,000	$36 to $42		
Brooklyn	700,000	$90		
Buffalo	180,000	$75 and $5 extra for every 100 messages over 1,000		
Charleston, S.C.	60,000	$60	$500	2½ per cent. on gross receipts.
Detroit	150,000	$72		
Duluth	20,000	$50		
Dubuque	30,000	$48		
Hartford	50,000	$40		
Lowell, Mass.	75,000	$40, $50, $60, $75		
Memphis	40,000	$50		
Milwaukee	140,000	$60, $70, $80, $100		
New Orleans	250,000	$96	$5 per pole	
Philadelphia	850,000	$120	50 cts per yr. for each attachment of a wire, $1 per yr. for each pole, $2.50 for each mile of wire.	
Kansas City	160,000	$72		
Portland, Me.	40,000	$40, $50, $60, $75		
San Francisco	300,000	$60 and 5 cents per message.		
Savannah	32,000	$46 to $60	$600 per annum.	
St. Louis	400,000	$50	$5 per pole per annum.	
Vicksburg	13,000	$38 to $48		
Washington, D.C.	160,000	$60, $80, $100		
Boston	360,000	$120		
Baltimore	360,000	$40 to $60		

The Electrical Supply Company people, agents for Stoddard Combined Rosette and Cut-Out, are constantly having their hearts gladdened by the complimentary notices and popularity of the device which permits the rosette and cord to be removed for replacing the safety device more readily than in other forms of similar apparatus.

Chicago, Oct. 20. C. C. H.

OUR BOSTON LETTER.

(Special Correspondence.)

Mr. E. S. Thomas of the Edison Laboratory, Orange, N. J., was a Boston visitor Friday and Saturday.

Mr. John I. Drake, Superintendent of the Rhode Island Electric Light Co., of Providence, paid the New England office of the REVIEW a call last week, as did also Mr. George F. Porter of the Faraday Carbon Company.

A small "C. & C." motor which was recently installed in a machine shop in Boston is now being used as a dynamo, steam power being applied, and is used to charge accumulators.

Mr. R. T. White, of Boston, is now putting upon the market probably the most complete line of street railway apparatus, surface, elevated, horse and electric, hitherto pushed by one concern. Mr. White is the inventor of the Acme Girder road-bed, which has been worked out, even to its minutest details, and has now a new conduit for electrical street railway work, the control of which some of the prominent electric companies would like to obtain. The elevated road question has also received much attention and some novel ideas are shown in this direction. Mr. White is prepared to show models and working drawings of all apparatus.

The Electric Club met informally at the club rooms on Boylston street, Wednesday evening, the occasion being the first regular "Wednesday evening talk" of the year. Vice-president Fuller was in the chair, and before introducing the speaker of the evening, called upon Mr. H. B. Cram, of the Entertainment Committee, who made a few general remarks on the plans of the committee in regard to the winter's entertainments. The informal talks will be a regular weekly feature and in addition papers will be presented from time to time by men eminent in the profession. The monthly dinners will also be continued. Mr. John C. Wilson was then introduced and gave an interesting description of the "Police, Alarm and Intercommunication System," which is largely in use in this city and elsewhere. Mr. Wilson had signal boxes and also a police station board on exhibition, and illustrated his remarks by showing the actual operations of the system. At the close of his remarks, a very general discussion was entered into regarding the system, and an opportunity given for asking questions in regard to it. The Saturday evening light lunches will be served the coming winter as usual.

The Society of '87, Massachusetts Institute of Technology, held its annual reunion at the Hotel Thorndike, Friday evening, and was largely attended, nearly 50 members from all parts of the country partaking of the Messrs. Damons' bounteous repast. Mr. George W. Davenport, of the Thomson-Houston Company, is vice-president of the society, but was prevented from attending by unavoidable circumstances. Among those present who are in the electrical business were Mr. Edward Blake, of the Sprague Motor Company; Messrs. F. Curtiss and H. C. Spaulding, of the Thomson-Houston Electric Company; Mr. H. D. Sears, of the American Bell Telephone Company; Mr. E. G. Thomas, of the Edison Laboratory, Orange, N. J.; Mr. W. S. Hadaway, of the Thomson-Houston Company, and Mr. G. W. Patterson, Jr., whose paper before the American Academy of Arts and Sciences on "Experiments on the Blake Contact," was published in the REVIEW in my last.

Quite an excitement was caused in Washington street, on Thursday evening, by an explosion in a manhole of the Edison underground conduit. The explosion was followed by a loud report and a column of water followed the iron cover several feet into the air. Luckily no one was hurt. The local papers are interviewing electrical experts around the city, and the affair will doubtless bring out many and varied theories as to the cause of this and prevention of future trouble of this kind.

The *Record*, whose crusade on the subject of burying the wires has now been carried on for two weeks, published in its Saturday edition a column interview with Mr. George W. Davenport, manager or the Thomson-Houston International Electric Co., which contains some very good ideas on the subject and which may well be pondered upon by these enthusiasts who insist upon all wires going under immediately. T. W. S.

Boston, Oct. 22, '88.

A Catalogue Worthy of Special Mention.

The Westinghouse Electric Company has just issued the most unique catalogue that has yet appeared, and as an artistic production it will be in demand in all quarters. It is carefully printed, covered with embossed heavy vanilla cardboard, in four different styles of bronze, and is clasped together by means of the McGill patent fasteners. It contains, in addition to descriptions of the various electric lighting systems, a number of striking sketches, as well as numerous beautiful and artistically executed engravings, descriptive of the electrical apparatus controlled by the Westinghouse Company. The engravings are from the well-known artists, Bartlett & Co., of New York, and reflects a credit of which they should justly feel proud. The Westinghouse Company has spared no expense in producing this publication, which cannot fail to attract great attention, and Mr. Wm. Lee Church, of that Company, has added another and most conspicuous triumph to his always striking work in this field.

The Board of Control and the Subways.

Our own New York Board of Electrical Control met last week and contested with several interesting and to them deep and surprisingly new problems, brought out by the complaint of the Western Union Company that their cables in the subways had been badly damaged by steam pipes.

Mr. Edward Lauterbach, president of the Subway Construction Company, read a report on the condition of the subways by the company's engineer, Mr. Beckwith. Mr. Lauterbach assured the Board that every improvement known to science had been employed in the construction of the subways. The Subway Company's engineer held that wherever the wires in the subways failed to act it was due to excessively high temperature in the manholes and conduits caused by the leakage from the Steam Company's pipes. Steam from leading pipes also destroyed the water-proof lining of the subways and ultimately deteriorated the wires. The Board should call upon the Steam Company to remedy this. The Construction Company had constructed 500 miles of single duct in 40 miles of trench, expending $1,500,000. The Metropolitan Telegraph and Telephone Company had 4,000 miles of wire in the ducts which operated splendidly. The Western Union distributing cables were found to work capitally.

Mr. Wallace C. Andrews, president of the New York Steam Company, said that all the leakage was due to a mistake of the engineer in one simple thing. He had used wooden wedges to key up the joints of the Broadway mains, instead of using cast-iron wedges, as he should have done. The difference in cost for the two miles of main laid with wooden wedges would only have been about $500. "This mistake," said President Andrews, "has already cost us $250,000. The vapor or steam which escapes into the streets comes from leaks in the Croton water mains which are above our pipes. In the particular case in Park row there were no leaks in our pipes, but in the Croton water pipes."

Commissioner Gibbens presented applications from electric light and power companies for permission to do business. The Manhattan Company was granted a franchise, the terms in substance being that the company is to pay to the city one cent per foot for each lineal foot of street occupied, and furnish the city free one arc light for every fifty supplied to its customers. The Electric Light and Power Company was also granted a franchise on the same terms.

Notes on the Zalinski Lecture before the Electric Club.

Captain Zalinski's paper on the uses of electricity in coast defences, read at the last meeting of the Electric Club, was received with great attention. For many of the members it was, if not a new subject, a very unfamiliar one. The lecturer gave a concise statement of the various systems for the defense of our harbors against hostile approach, and the statement involved a good deal of most interesting history.

It shows that, after all, we possess a corps of army and navy officers whose engineering skill and ability are second to none, and whose inventive faculties are as strongly developed as those of their commercial and manufacturing brethren. In many cases these may be asleep from inaction, but let the bugle or the drum once sound the call, and instantly every nerve will be alert and the dogs of war will soon show their fangs, and the next war will prove that the mythological picture of Jove with a handful of thunderbolts was prophetic.

Truly times change. A quarter of a century ago began the contest of impregnability in war vessels. A limit had been reached and the question to-day is how best can these leviathans be destroyed when they get uncomfortably close? And the settlement of this question will most assuredly depend largely on the wonderful force we have now learned to harness in a way which precludes the taking of the bit in its teeth and defying us. Dirigible torpedoes, for instance, are utterly impossible without the electric current to guide them to the target. Systems of submarine torpedoes will depend upon the electric current for explosion at the proper instant, whether based upon electro-mechanical alarms or range-finding charts, and the thunderous throats of modern guns await the touch of the button or key to belch forth their terrifying din and the death-dealing missiles of modern warfare.

Electric Club Notes.

D. Van Nostrand, the publisher, has very kindly presented the Club with new books on electricity.

Mr. Thomas P. Conant, of the Electrical Committee, left for Chicago last Monday and will spend several months in that village.

The proposed amendments to the By-Laws will bring out a large attendance of resident members—the voters—at the Club meeting November 15.

Mr. F. W. Jones, of the West Coast Telephone Company, has loaned the Club a valuable copy of Falero's great picture, the "Marriage of a Comet."

Capt. Zalinski's lecture was one of the most interesting ever listened to by the Club, and was an auspicious opening of the series of meetings announced for the fall and winter at the Club.

Dr. De Baussett, the air ship builder, whose plan for aerial voyaging has been recognized by a government appropriation, was a visitor at the Electric Club last week, and an attentive listener to Capt. Zalinski's address.

The address of Capt. Zalinski attracted the attention of the daily press of New York, the *Times*, *Tribune*, *Sun* and other journals publishing excellent summaries. The lecture is to be published in pamphlet form by the Club and sent to all members.

Some 30 new members have recently joined the Club, among them Erastus Wiman, C. S. Bradley, J. L. Blackwell, E. A. Leslie, Dr. C. W. Saunders, H. M. Livor, of New York; H. C. Sprague, Kansas City; R. D. McGonigle and C. H. Baxter, Pittsburgh; W. A. Kreidler and A. B. Dick, Chicago; A. P. Seymour, of Syracuse; T. H. Brady, New Britain.

Electric Light Association Headquarters on Fire.

On Friday last the new headquarters of the National Electric Light Association, 16 East 23d street, this city, came near being destroyed by fire. Mr. Garratt, finding the office uncomfortably cold, opened the register, whereupon instead of warm air coming from the "hole in the floor," red tongues of fire and a dense volume of smoke issued forth. An alarm was promptly rung in and in a very short space of time a two inch stream of water was pouring into the basement, from whence the fire seemed to come, and in ten minutes all danger was over. Considerable interest was shown by all parties concerned, as to the cause of the fire, and many inclined to the opinion that the great amount of electricity that is popularly supposed to center around the Association Headquarters had settled in the cellar and taken fire by spontaneous combustion. Upon examination, however, a defective cold air box was found guilty.

Telephonic News

*** The City Council of Chicago has passed the telephone ordinance which was recommended by the majority of the Committee on Licenses. Its most essential feature is the reduction of telephone charges, now $125 per instrument, to $95 for the first year, $85 for the succeeding years, and $75 in case three-year contracts are made.

*** Enormous quantities of iron tubing will be required within the next year or two to supply the demands of the telegraph and telephone companies, some of whom are now busily engaged in laying conduits for their underground wires. Already large orders have been placed for tubing for this purpose, which accounts for the present unusual activity of the pipe mills.—*Philadelphia Ledger.*

*** A telephone line has been installed to Cairo and Alexandria, and great exultation is shown in Belgium that a Belgian system, that of Van Rysselberghe, has been selected, one of the Brussels journals remarking: "Recently we were the first to announce the establishment in Portugal of a telephone line on the Van Rysselberghe system. We learn that a new application of the invention of our learned compatriot has just been realized with complete success between Cairo and Alexandria. We may add for the honor of our national industry, that in Egypt as in Portugal, all the material employed is of Belgian manufacture, and comes from the workshops of Mourlon, of Brussels. The conductor wires of the line from Cairo to Alexandria being of Montefiore phosphor bronze, it has been found possible to utilize for communication between the lines of these two places the iron telegraph wires, and that without deranging anything in their first destination. This is the system which has been applied on all the Belgian State lines, and which gives results so much better than some others which are spoken of as being in a higher state of perfection. From this point of view the use of the Dejongh transmitter cannot be too much recommended for adoption by our telegraph administration for its Ostend line, and for communication between Paris and Brussels, It must not, however, be lost sight of, that above a certain distance words cannot easily be transmitted by an iron wire, and that has decided the Belgian Government to replace proportionally, to wear and tear, iron wire by that of phosphor bronze. When this substitution is accomplished, our telegraph lines will have, thanks to the Van Rysselberghe system, a double use, telegraphic and telephonic, so that the working, instead of being carried on at a loss, will result in important profits."

Gilman's Multiple Electric Indicator.

Various devices are in use for indicating the whereabouts of occupants of offices in public buildings, that in most common use being the card indicator placed on or near the door of the office to which it pertains. This, however, does not obviate the necessity on the part of the caller of climbing several flights of stairs, which, if the tenant is out, is very annoying, to say nothing of the loss of time.

We present this week illustrations of a multiple electric indicator system, which will be recognized as of value for its convenience, and as a time and labor saver. The system consists essentially of a set of small indicators, to be placed one opposite the name of each occupant of an office building, as usually shown on the bulletin board at the entrance. These indicators contain a revolving drum, and thus the slit in front may show several different readings, as for instance, "In," "Out," "Return Soon," etc. Small wires connect the indicators with index discs, placed upon the floor on which the offices are located. Pressure upon a button clearly marked with the user's name closes the circuit which passes through coils in the lower indicator, drawing inward an armature, which, connected by a small arm and ratchet with the drum, moves it a fractional part of a revolution, successive pushes thus accomplishing a complete revolution, and bringing whatever reading is desired opposite the outward opening. By a mechanical device, a pointer on the push button revolves in unison with the indicator drum, so that a person using the system may know just what the reading is at the lower indicator.

The figure shows on the left the index discs, placed conveniently on the elevator doors, while the upper portion on the right is an enlarged view of two discs showing the push button and pointer, successive pushes on the former moving the pointer around the disc from "In" to "At Dinner," then to "Return Soon," etc., and also making the electrical connection which revolves the drum to the corresponding legend in the indicator at the entrance. The lower right corner shows the regular building directory, with indicators placed opposite each name.

Further reference to the plate will show, immediately beneath the disc indicator on the elevator, the words "Elevator Running." The latter is operated from below, or other convenient place, pressure upon the buttons causing the words "Elevator Running," or "Elevator Closed," to appear as desired, on each floor, thus saving time of waiting when elevator is not running.

It frequently happens that a caller has business with more than one office on the same floor, but at some distance from the one just left. As the elevator is usually centrally located, an inspection of the indicator board thereon gives him the desired information, in many cases saving a useless journey. The system may be quickly and cheaply applied to any building without tearing out the walls or floors, and is, consequently, easy to keep in repair. The company have also an electrical indicator of similar construction, for use in keeping time of employés in large mills or factories; an indicator placed in the office and connected with an employés' call board, which is to be placed near the point of ingress and egress.

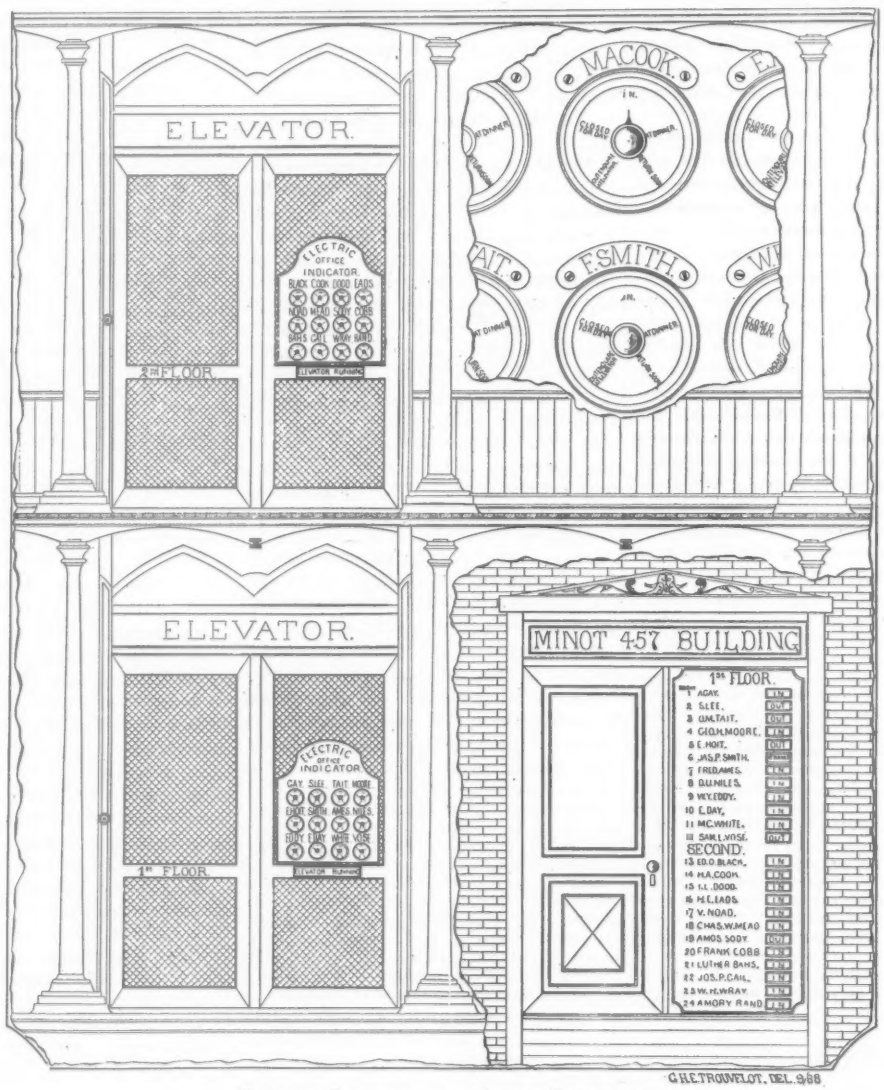
*** Telephone connection has been successfully made between Buffalo, New York, Philadelphia, Troy and Boston, the distance to the latter city being 810 miles. This is the longest telephone circuit in the world.

Electric Welding.

BY C. J. H. WOODBURY, OF BOSTON, BEFORE THE AMERICAN ASSOCIATION OF MECHANICAL ENGINEERS, SCRANTON, PA.

The smith is the highest type of handicraftsman; he alone of all artisans making his own tools, and also those of others, commands the dependence of all upon his offices. His work is prehistoric, reaching beyond records or traditions, and known to have existed in still earlier times through the personifications of mythology, wherein Vulcan was essential to other divinities. The blacksmith is a factor in every stage of the history of mankind; and his work is now, and always has been, a matter of individual skill depending upon a keen eye and steady hand, with a fine sense of form and dimension, untouched by the flood of invention which has modified, or even recast other methods of production.

It is true that machinery is used in welding, but it is merely devoted to the application of power to supplement the limits of human strength; and with trip hammer and crane the same skill is necessary as with hammer and anvil.



ELECTRIC INDICATOR FOR OFFICE BUILDINGS.

Since the first of the year there has been a commercial application of electric welding, the invention of Prof. Elihu Thomson, which has already reached a degree of importance sufficient to render it a live issue in every branch of manufacture to which it has been shown to be applicable.

This process is a new art, for, unlike the smith who is confined to iron, steel and platinum, it can weld any two pieces of the same metal or alloy ranging from the most refractory metals to the alloy which fuses at 162° Fahr. It will join dissimilar metals when the welding point of one is not too far in excess of the fusion point of the other.

These results seem to indicate that the classification of metals into welding and non-welding has been due to imperfections in the ordinary and time-honored methods, rather than any peculiarity in physical constitution warranting such arbitrary classification.

It is true that some of the metals have been joined without solder by means of the autogenous soldering process, wherein local fusion is produced with an oxyhydrogen blowpipe, but that laboratory experiment is not a union of metals heated to a plastic condition which precedes fusion, according to the accepted meaning of welding.

Passing by the scientific interest of electric welding, a short allusion will be made to the principles upon which it is based as preliminary to a description of the apparatus, and then consideration will be given to its practical applications.

THE PRINCIPLES.

All forms of matter possess in varying degree the susceptibility of permitting the molecular motion necessary for the transfer of electric energy; those whose characteristics are favorable for such motion being termed conductors, and those which do not readily permit such motions are called non-conductors or insulators; and various adjectives are frequently used to express in a general way some sense of their value, but throughout the whole list of all known matter, there is some measure of conductivity, and the whole expression is one of degree; the conductivity of silver, for example, being over one hundred billion times that of glass; and other materials possess measures of conductivity lying between these extremes. The ability of anybody to conduct electricity in comparison with others of its kind is directly as the area of the cross section and inversely as the length.

Whenever electricity is provided with what is termed a good conductor, it makes no manifestation of its presence, but if there is poor conductivity by reason of small cross section or poor conductivity of the material, there is resistance to the electricity. Then a portion of the electric energy is expended in producing excessive molecular motion, and converted into heat, which is radiant if the temperature is high enough, as in the case of the incandescent light, when the metal portion of the circuit possesses ample conductivity to carry the electricity without appreciable heating, but the carbon filament in the lamp is a poor conductor, both in regard to physical characteristics of the material and small cross section, and the molecular motion is so violent as to produce a temperature sufficiently great to contain light rays.

The total amount of mechanical work done by a current C in overcoming a resistance R during a time T, is RC^2T; and the equivalent amount of heat is obtained by dividing the expression by J, the mechanical equivalent of heat.

$$H=\frac{RC^2T}{J}.$$

In an induction coil, electricity of large current and low pressure is converted into an equivalent electrical energy of small current and high pressure, by means of a bar of soft iron or a bundle of wires, wrapped with two

coils of insulated wire of different lengths and diameters. An alternating current being sent through the shorter wire alternately magnetizes and demagnetizes the iron bar with reversed magnetic polarity, and reversals of magnetism in this bar in turn produce an alternating current in the circuit of which the secondary coil is a portion; the secondary current being, as stated above, of high potential and small quantity.

By suitable structural changes, an induction coil can be inverted as to its functions, and used to convert small electric currents into large ones, with inverse changes in potential.

THE APPARATUS.

The electricity is generated by one of two methods. In the direct system, the dynamo is contained in the machine below the clamps, and the armature contains two windings; the one being a fine winding which is in series with the field magnetic coils, and the other winding being merely a bar of copper in the form of a letter *U* or less than a single coil. This bar being of very low resistance, the maximum current is sufficient for welding purposes, and the terminals are connected directly to the copper clamps. Alternating currents are generated in this machine, and used for welding, in order to avoid commutators, which are necessary in direct current machines. It should be remembered that in all dynamos the electricity is generated in alternating currents, and that these currents are in proper turn fed to brushes of opposite polarity, and thus rendered continuous. In an alternating current dynamo, the electricity is conducted from the armature to rings instead of to a commutator, and is thus better suited for large currents, and some forms of the apparatus do not require rings or any moving contacts. There is no electrical reason why an alternating current should be used except the convenience of its manipulation. In fact, the continuous current supplied by secondary batteries has been used for this purpose.

Another form of apparatus termed the indirect system is more conveniently suited for large work, or in places where a number of welding machines are operated by the current from a single dynamo. The welding current is produced by conversion of the comparatively high tension current by means of an inverted induction coil, termed a transformer. The primary circuit from the dynamo is conducted through many turns of fine wire wound around a soft iron ring, and upon this same ring is a single turn of a large copper bar in which the welding current is produced by an inductive effect. These currents receive 4,000 to 15,000 alternations per minute. The welding currents are not changed suddenly or by switches, as such manipulation would not be desirable or even practicable with the great currents used; but in the direct welding machine, a set of resistance coils is placed in the fine circuit which passes around the field magnets, and by interposing more or less of the resistance coils in this circuit, the strength of the magnets is diminished or increased, and the welding current altered accordingly.

With the indirect machine, the amount of the secondary or welding current is controlled by varying the current in the primary coil by means of a kicking coil, or by a variable shunt to the field coils and in other ways.

In either case the apparatus is simple and in full and complete control at will of the operator by movement of a lever, and this action controls the heat.

THE PROCESS.

In the electric welding process, the two pieces to be joined are secured in firm end contact by a pair of adjustable copper clamps which are placed upon the top of the apparatus. An electric current of large volume is passed through the pieces, and the contact between them being of less conductivity than the homogeneous metal, heating ensues at this place, as the juncture is brought to the proper temperature by the gradual motion of the regulating lever, and as the metal softens, the clamps are pressed towards each other to insure a continuous metallic union across the bar.

The weld begins at the centre and proceeds radially towards the surface, as the temperature becomes greater than at the interior. The heating is further increased by the fact that the resistance of the hot metal is greater than that of cold metal.

The enormous electric currents used in this welding process sometimes reach 50,000 amperes, but with an electro-motive force of half a volt, and therefore not capable of giving any sensation to a person.

It would be injudicious to offer any premium upon ignorance, but the operation of electric welding is one of the simplest mechanical processes, requiring but little skill on the part of the operator in comparison with that exact training of hand and eye and long experience necessary for ordinary welding. The operator must understand the color of the proper welding heat of the metal under treatment, but this is readily learned. The work is not manipulated during the process, except when it is desired to reduce the burr at the weld, and is at all times under observation, and its heat subject to entire control by means of a lever which graduates the strength of the current.

The dynamo generating the electricity is self-regulating, and requires no attention except for lubrication.

There is no unnecessary waste of fuel, the heating being local, and does not extend far from the weld: cotton-covered wire one-fourth of an inch in diameter can be welded without searing the insulation over three-fourths of an inch from the weld.

The time for making a weld varies from a fraction of a second to about two minutes, according to the work; although nothing over two inches diameter has yet been welded, but larger machines are in process of construction.

It is not necessary to provide motive power fully equal to the maximum demand, as the time is so short that the momentum of a fly-wheel will serve the same purpose as in a drop press, and give up the surplus energy required.

The power is inversely proportional to the time, and appears to be about proportional to the 2.3 power of the diameter in inches, with a slight variation in favor of quick work caused by differences in rates of thermal conductivity of the material.

APPLICATIONS.

The process is far cheaper than that of hand welding, and also extends to other methods of manufacture, but the comparative expense differs according to the previous conditions in every place where it has been applied thus far.

Its applications in practical work thus far have been confined to butt welding for many purposes, such as continuous wire work, carriage work, axles and tires, cotton bale ties, barrel hoops and wire cables and many miscellaneous purposes. Axes are made of drop forgings, joining the tool steel edge to a mild steel poll, bars are heated in the middle and upset forming collars, and pipes are joined together—a matter of great value in ice machines. The list might be continued to greater length, but this indicates the range of its practical uses at this early day.

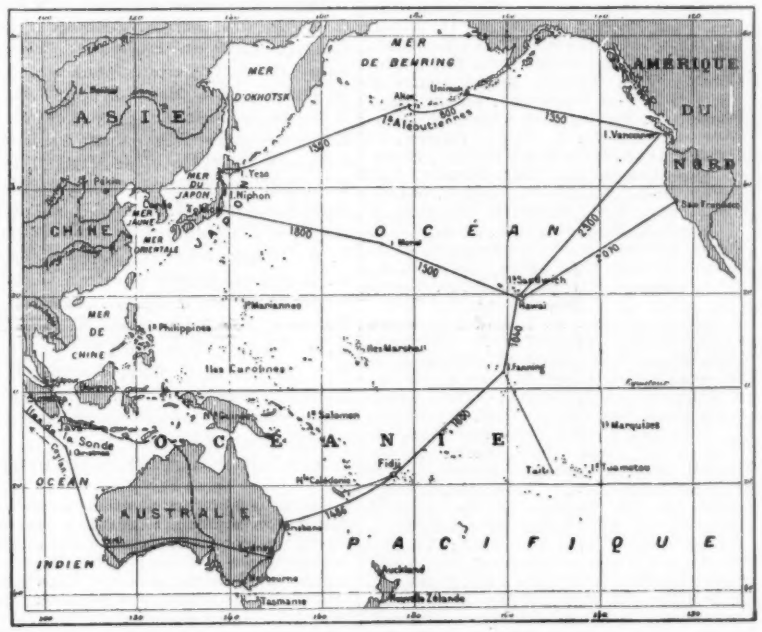
STRENGTH OF ELECTRIC WELDS.

The value of the process, for most purposes, independent from any scientific interest or mechanical ingenuity shown in the apparatus, must be that of the resistance of the welds under tensile stress.

It will be readily understood however, that, as this process accomplishes many things hitherto impossible, aside from any question of ultimate strength, it is fitted for applications in many constructions where it saves labor and time; provided only that the joints be in all cases sufficiently good for the purpose for which the article is designed. A large field thus opens up in the execution of ornamental design in metal work, where it will supplant screws, rivets or solder for fastenings, and in other evident applications.

There is no reason why such a weld should be stronger than the rest of the bar, but if averaging of equal strength some of the breaks would occur at the weld. There have been many tests made on various testing machines, but it has been considered preferable to submit only the official record of tests made on the Emery Testing Machine at the U. S. Arsenal at Watertown, Mass.

To clean rusty iron dip it for several hours in a pretty strong solution of chloride of zinc; if the solution has an excess of acid the clean iron will be attacked. When the rust is removed wash with water, then with ammonia, and dry rapidly. The appearance of objects treated in this way is like frosted silver.



Electrical Matters in Honolulu.

TO THE EDITOR OF ELECTRICAL REVIEW:

One would hardly think of going into the middle of the Pacific, to a country just emerged from barbarism, to find modern electrical developments, but it is questionable if there is any place in the world so thoroughly up with the times in this respect as Honolulu, the capital of the Hawaiian Islands. With a population of about 2,000 it supports two telephone companies, having altogether a thousand subscribers. Every tradesman has one in his store, and almost all residences of foreigners are supplied, so that it is possible to talk to almost any one of your acquaintance in the town and transact all necessary business at the telephones. The Mutual Telephone Co. ran a wire over the reefs to connect with vessels in the harbors, and many a long pull ashore was saved by a shout "hello!" Several long lines extend to the plantations and ranches outside of the town. The convenience of the telephone is probably better illustrated here than at any other town in the world, and is due to its universal use, which in turn is brought about by low charges, these ranging from $24 to $36 a year. It is interesting to note that at these rates the companies state that they make money.

Electric lighting is represented by the Thomson-Houston Co., who had a station three miles out of town up the Nuuanu Valley, operated by water power, from which they light the town with about sixty arc lights. The lighting is under control of the Government, and is admirably carried out. It is intended to increase the plant by the introduction of alternate current dynamos for incandescent lighting, and while the manager, Mr. Faulkner, has gone to the States to procure the apparatus, a large reservoir to supply an increase in water power is in process of construction, to admit of future development. At present incandescent lighting is represented only by a Thomson incandescent plant of two 200 light dynamos which light the Palace and Hotel. Honolulu is wide-awake electrically, and has energetic and capable men to advance electrical interests.

Honolulu, Sept. 17. J. B. M.

The Bentley-Knight Electric Railway Company has moved its general offices to 25 and 27 Tenth avenue. The company will still keep open a down town office at 115 Broadway, New York.

The Schenck Belt-Holder and Shifter Company has shipped recently machines to be used in connection with pulleys 72 inches in diameter, running 12-inch belts. The company has been particularly successful in controlling wide and heavy belts, and also carries in stock machines for small pulleys and narrow belts. We understand that they are securing reliable machinery houses as selling agents in different parts of the country.

TELEGRAPHIC

.... Charleston, S. C., is asking for better telegraph service.

.... The trustees of Fresno, Cal., have granted a telegraph franchise to the Postal Telegraph Company for 50 years.

.... The boxes and machinery for the Gamewell fire alarm system have arrived in Mobile, Ala., and will be erected at once.

.... The fire alarm system, put in by the Gamewell Company, of Chicago, at a cost of $3,000, has been accepted by the city of Elgin, Ill.

.... Maurice J. Hart and others asked for a permit to build an electric road in New Orleans. The Mayor vetoed the ordinance granting them the right, recommending that it be changed.

.... W. M. Talcott, an old time telegrapher, has blossomed out into an electric motor man, agent for Vulcan line wire, and all that sort of thing, at 117 Dearborn street, Chicago.

.... It is rumored that so soon as the financial arrangements have been completed the Antilles Cable Company intends to extend its system from Cuba to some point on the Mexican coast, and touching, if landing rights can be there obtained, at Vera Cruz.

.... Mr. J. E. Land, formerly of Chicago, will in future make his headquarters in Dallas, Texas, representing among other concerns, the Fisher Motor Company, the Western Electric Company, and the Mather Electric Company, for Arkansas, Louisiana and Texas.

.... The John T. Noye Manufacturing Company, of Buffalo, has just issued an illustrated catalogue of the Rice automatic engine as applied to electric lighting. In addition to a number of elegant illustrations of the engine, several diagrams of electric light stations where the Rice engine is used, are given.

.... A telegraph wire which workmen were stringing over houses in Providence, R. I., slacked down into the street just as a horse came dashing along. It caught the animal squarely in the mouth, as does the bit, but fortunately the horse was not injured in the least, though the contact brought it to a sharp halt and tossed its head back in a way that alarmed the driver.

Cables Under the Pacific.

Most readers will be surprised to learn from the accompanying map how many miles of cable have been laid under the Pacific Ocean. The laying of these cables have given a curious importance to several otherwise insignificant little islands. One among them is the island of Fanning, south of Hawai, discovered in 1824 by the American captain whose name it bears; it is but a few miles in area, and has only 150 inhabitants; but it has excellent water and a good harbor. Another is the island of Christmas, south of Java, which is almost inaccessible. Yet both of these have been annexed by the British Admiralty, and are likely to be of importance in the political geography of the future.

Along the course of the American line to Japan, 1,500 nautical miles from Hawai, is the island Morell, whose very existence has been questioned by most chartmakers; this must ultimately, in spite of the Monroe doctrine, fall under American influences.

But the French have already large interests in the Pacific, and confident of the ultimate success of the Panama Canal, *Électricité*, from whose pages we draw these facts, does not hesitate to put on the map, though in dotted lines, the course of two more cables that must soon be laid, the one to Tahati, the other to New Caledonia.

It is further interesting to note how much shorter the longest of these lines is than the Atlantic cables.

Electric road mileage bids fair to be increased largely in the vicinity of Amesburg and Newburyport, Mass. The latest rumor is that Haverhill will be connected with Amesburg.

An electric road in Norwalk, Ct., is being talked of to replace the horse railroad connecting Norwalk borough with South and East Norwalk, Winnipauk and Wilson's Point. Mr. J. H. Lee is organizing the movement aided by Senator E. J. Hill and John D. Kimmey.

The Manchester, N. H., Horse Railroad Company has invited proposals from the Sprague Electric Railway Company, of New York, for the equipment of the main line from 'Squog to Webster street, with its electric apparatus for running cars in place of horses.

General Notes of the Street Railway Convention.

WASHINGTON ELECTRIC ROAD.

Mr. George Truesdell, president of the Elkington and Soldiers' Home Railway, invited the members of the convention to visit and inspect his road. This road is operated by electrical power under the Thomson-Houston system.

This road is one embodying all the methods of overhead construction that are generally employed, and is the first instance in this country of a line constructed with poles in the center of the street. These poles are lighted with clusters of incandescent lamps. It is part double track and part single. The total length is 1.8 miles; maximum gradient, 5 degrees. At present there are only three cars, but it is proposed to greatly extend the road this coming spring.

As it embodies all the fundamental principles of the Thomson-Houston system, it was well worthy of inspection, and the visitors were greatly pleased with all they saw.

THE SPRAGUE EXHIBIT.

The Sprague Electric Railway and Motor Company, represented by F. J. Sprague, H. McL. Harding, A. H. Chadborne and William Hazleton, show a new type of Sprague electric street car motor. It is built in two sizes, of 7½ and 15 horse power capacity, and these are identical in general appearance. They are adapted to be applied either to standard cars or to special trucks. They have the regular Sprague mounting, being centered on the axles and flexibly suspended. They are very compact and powerful, and embody the most recent improvements to meet the exigencies of street car service. The armature pinion meshes into an intermediate with vulcanized fibre teeth to insure quiet running and the pinion of this shaft into the main gear. All bearings are self-oiling and independently removable. Everything is designed for great strength and ready replacement. The brushes are remarkable for ease of adjustment, and are made on a new principle. The gears are of small diameter and symmetrically placed.

A tight-fitting cover, moving with the machine and enclosing the gears as well, may be attached. Both the armature bearings, which are self-centering, and intermediates, are fitted with oil and dust guards.

The evident design is to not only make the machine very strong and readily accessible, but to reduce the attendance and ease to a minimum.

THE BENTLEY-KNIGHT ELECTRIC RAILWAY COMPANY.

The Bentley-Knight Railway Co. had headquarters at parlor 26, and has made a special feature at this convention of its conduits for electric sub-surface conductors. It had on exhibition the first iron conduit ever constructed, a section of the conduit now successfully operated on the Observatory Hill Passenger Railway at Allegheny City, Pa., and also a section of the new and improved form of conduit, now being laid for the West End Street Railway at Boston, Mass. The company exhibited plows and other details employed with the conduit system, both new and those which have been running for a lengthy period on the Observatory Hill Road.

Numerous photographs and drawings of cars, motors and conductors, elevated and underground, constructed and operated under the Bentley-Knight System gave interest to the exhibit.

The company was represented by Mr. R. W. Blackwell, president, and Mr. J. L. Blackwell, secretary.

THE DELEGATES PRESENT.

The following is a complete list of the delegates that have reported to the secretary:

E. G. Mosher, Augusta & Summerville Road, Augusta, Ga.; Nelson Perin, Geo. C. Jenkins, Baltimore Union Road, Baltimore; D. F. Longstreet, M. F. Dickinson, West End Road, Boston; Albert Eames, B. F. Lashar, Bridgeport Road, Bridgeport, Conn.; Horace B. Rogers, Brockton, Mass.; William Richardson, William J. Richardson, Atlantic Avenue Road, Brooklyn, N. Y.; Samuel F. Lewis, H. M. Thompson, Brooklyn City Road, Brooklyn, N. Y.; George W. Van Allen, Charles E. Harris, New Williamsburgh & Flatbush Road, Brooklyn, N. Y.; Charles B. Holmes, T. C. Penington, Chicago City Road, Chicago; H. H. Littel, Cincinnati Inclined Plane Road, Cincinnati; John Harris, Cincinnati Street Road, Cincinnati; G. B. Kerper, Mount Adams & Eden Park Road, Cincinnati; Edwin Duty, Charles W. Wason, East Cleveland Road, Cleveland; Charles B. Clegg, Dayton; S. Hendrie, Detroit City Road, Detroit; Henry A. Sage, Easton, Pa.; John Bowker, Fall River, Mass.; William H. Sinclair, Galveston, Texas; E. S. Goodrich, Hartford & Wethersfield Road, Hartford, Conn.; C. B. Holus, Citizens' Road, Indianapolis; J. H. Small, Pavonia Road, Jersey City, N. J.; E. J. Lawless, Metropolitan Road, Kansas City, Mo.; T. J. Minury, Central Road, Louisville, Ky.; H. H. Littell, City Road, Louisville, Ky.; Charles Odell, Newburyport, Mass,; D. B. Hasbruck, Broadway & Seventh Avenue Road, New York; George S. Hart, Milton I. Masson, Central Crosstown Road, New York; C. D. Wyman, J. L. Valentine, Central Park and North & East River Road, New York; Edwin Bedill, Harlem Bridge, Morrisania & Fordham Road, New York; Aaron Raymond, W. H. Delany, North & East River Road, New York; George S. Hart, Second Avenue Road, New York; Thomas H. McLane, Twenty-third street, New York; Benjamin Flagler, Niagara Falls, New York; C. Q. Richmond, Hoosac Valley Road, North Adams, Mass.; James W. Hyatt, Norwalk Road, Norwalk, Conn; Thomas C. Keefer, Ottawa, Canada; D. F. Longstreet, Pawtucket, R. I.; H. R. Woodward, Central Road, Peoria; J. H. Hall, Fort Clarke Road, Peoria; T. C. Barr, People's Road, Philadelphia; E. B. Edwards, Ridge Avenue, Philadelphia; T. W. Ackley, Thirteenth and Fifteenth Street Roads, Philadelphia; William McCreary, Federal Street Road, Pittsburg; Charles Atwell, Alleghany & Manchester Road, Pittsburg; Jessie Metcalf, Union Road, Providence, R. I.; Lorenzo Bull, Quincy, Ill.; B. F. Owen, James L. Douglas, Reading, Pa.; C. C. Woodworth, Rochester, New York; Charles Odell, Willard B. Ferguson, Naumkeag Road, Salem, Mass.; Orson P. Arnold, Salt Lake City, Utah; A. E. Smith, F. E. King, Springfield, Mass.; Ross Mitchell, W. H. Hanford, Citizens' Road, Springfield, Ohio; Robert McColloch, Benton, Bellefontaine Road, St. Louis, Mo.; John H. Maxon, Lindell Road, St. Louis, Mo.; Julius S. Walsh, Cass Avenue Road, St. Louis, Mo.; W. Bartlett, Missouri Road, St. Louis; Charles Green, People's Road, St. Louis; W. L. Johnson, Southern Road, St. Louis; Christian Peeper, St. Louis Road, St. Louis; John Scullin, Union Depot Road, St. Louis; J. E. Bailey, D. E. Bailey, A. E. Lang, Toledo, Ohio; Chas. Cleminshaw, Chas. H. Smith, Troy, New York; Charles White, W. E. Boughton, Andrew Glass, Capitol & North O Street Road, Washington; Henry A. Willard, W. H. Clagett, A. Clagett, Columbia Road, Washington, D. C.; George Truesdell, E. Kurtz Johnson, C. C. Duncanson, Joseph Paul, Eckington & Soldiers' Home Road, Washington; George W. Pearson, A. A. Wilson, W. J. Wilson, Robert Beall, Metropolitan Road, Washington; H. Hurt, C. C. Sailer, Washington & Georgetown Road; Franklin J. Mallory, A. E. Doubleday, North Hudson Road, Hoboken, New Jersey; W. W. Ward, New Haven & Westhaven Road, New Haven, Conn.; C. B. Pratt, H. S. Seely, Worcester Consolidated Road, Worcester, Mass.

ELECTRICITY OUR DEFENCE

The Electric Club Listens to an Important and Interesting Lecture by Capt. E. L. Zalinski, U. S. A., Entitled "Electricity as Used in Sea Coast Defence."

THE ADDRESS IN FULL WITH A REPORT OF THE DISCUSSION.

The regular monthly meetings of the Electric Club at its club house, 17 East 22d street, for the season of 1888-9, were commenced last Thursday night, October 18th. After an excellent dinner, that was enjoyed by about 50 members, the lecturer of the evening, Capt. E. L. Zalinski, U. S. A., whose work with the dynamite gun is widely and favorably known, was introduced by President H. C. Davis, and delivered his address, illustrated by the stereopticon, which was most attentively listened to by an audience that filled the assembly room.

A business meeting of the Club was held after the lecture, and amendments to the Constitution and By-Laws of the Club, proposing an increase of the entrance fee and dues, and also limiting the membership of the Club to 750—450 resident and 300 non-resident—were submitted, and will be voted upon at the next regular meeting of the Club.

Among the gentlemen present were Henry C. Davis, Geo. Parsons Lathrop, Francis Lathrop, Jarvis B. Edson, Dr. Otto A. Moses, Dr. A. V. Garratt, Frank Mason, T. W. Osborn, Capt. Henry Erben, U. S. A., Willard L. Candee, C. O. Baker, Jr., M. W. Goodyear, Geo. Worthington, Thomas P. Conant, E. A. Colby, Wm. Marshall, Capt. E. L. Zalinski, U. S. A., George B. Coggeshall, J. J. Carty, H. A. Reed, Lieut. Zalinski, U. S. A. (brother of the lecturer), Lieut. F. W. Toppan, U. S. N., James Kempster, M. M. Garver, Ronald Crawford, Chas. W. Spear, C. W. Price, H. N. Grandin, O. Hoftman, P. H. Alexander, W. H. Baker, H. H. Sherman, C. P. Bruch, Col. S. J. Fox, New Haven; A. B. Dick, Chicago; H. D. Stanley, Bridgeport; S. E. Barton, Boston.

The address in full and the resulting discussion are given herewith:

ELECTRICITY AS USED IN SEA COAST DEFENCE.

The applications of electricity to sea coast defence are so numerous that it is not practicable to more than briefly touch upon its various uses. Nor is it possible, in presenting the matter to this audience, to give much that is novel to most of the gentlemen composing it. I may possibly turn the attention of some to work out problems not yet satisfactorily solved. Let me give the warning, however, that invention in the direction of war appliances are very rarely profitable. They demand long continued persistence of efforts and great expenditure of money before the conservatism of Government officials can be overcome, and novel methods and appliances are adopted. Besides this conservatism, there exists the many practical difficulties which the sanguine inventor is apt to overlook at the inception of his work, but which present themselves continuously, so that ultimate success is like an *ignis fatuus*, ever within sight and just beyond reach.

We have the following applications of the subtle force of nature called "electricity":

Communication.
Range and position finding.
Lighting.
Motors for manipulation of guns.
Dirigible torpedoes.
Ignition and firing of mines, torpedoes and guns.

The ordinary uses of electricity for communication are well known to you.

The permanent defences with which we are at present concerned, will doubtless be supplied with permanent lines of wiring, in subways, well protected from injury by the enemy's fire. To provide for emergencies, the more important lines will be duplicated. But, in addition to this a field equipment of insulated wire on reels which can be easily carried by one or two men must be provided.

European armies are supplied with a field telegraph equipment which provides both for the permanent work of connecting the armies with their bases and the temporary lines which are used in active operations on the field of battle. The ordinary telegraphic apparatus has seen practical service in our own war. But the equipment of light insulated wires, on portable reels was not then developed and has been brought into use only recently.

Knapsacks having reels containing one quarter mile lengths have been made in England and Germany. These can be slung on the back and manipulated by a single man. The light cables made abroad were found of inferior insulating qualities. Upon presenting the matter to our own manufacturers decidedly better cable for service have been produced.

It is still an open question as to the instruments best fitted for electrical communication in time of battle. The telephone does not appear to fully meet the requirements when the surroundings are noisy. The dial telegraph is not always reliable and appears to get easily out of adjustment. It requires the closest attention where a code of abbreviations are used and there is no check of a record, to fix responsibility for errors. A reliable printing telegraph is a desideratum for this work and I should be pleased to be advised as to the present existence of such. The only thing at present available is the Morse instruments with recording attachments. But these require some previous skill in transmitting as well as receiving, whilst a printing telegraph can be worked by any intelligent man, without previous instruction or practice.

The telephone has been used as a receiving instrument in connection with a Morse key, but the same objections pertain to this combination as to the ordinary key and sounder.

Professor Gray's writing telegraph, if reliable and not too delicate, will be of very great value for military use, and I hope that all it promises will become accomplished facts.

Besides communicating directly, through the medium of wires, we have communication at night by means of flash lights, and by lamps suspended at considerable heights, both from small balloons and from kites. The circuit is made and broken by a key, so that the Morse code can very readily be used. Owing to the skill and practice required to distinguish and read the long and short flash method from a single lamp, a double lamp system has been devised. One form, invented by Lieut. John P. Finley, Signal Corps, U. S. Army, consists of two lamps at the extremities of a short cross-bar, having a theodolite at the middle, all being supported on a tripod. It would appear to me that a triple lamp system, having the third lamp mounted a few feet above and between the others, would afford greater certainty of results; the middle lamp retained constantly alight, serves as a definite reference point for the flashes of the other two.

The object of "range and position finding" is to rapidly ascertain the distance and location of the enemy's ships. In this way guns can be directed without the target being visible to the gunners. As the smoke very quickly obscures the direct field of view, it will be seen how essential a proper system of range and position finding is to an efficient artillery defence. Experimental firing made with the assistance of such a system, the gunners in laying their guns not seeing the target, has given better results than when the guns were sighted directly on the target. This has been particularly the case where the target was in motion.

Range and position finding is also necessary for the operation of systems of fixed submarine mines, where they are exploded at the will of an operator.

In all cases the distances are plotted on maps divided into numbered square. Tables are provided for each gun giving the horizontal and vertical angles necessary to attain the middle of each square. The traverse circles are divided for the horizontal angles, the meridian line being usually taken as the zero line. The number of the square into which the target is likely to move, being telegraphed to the gun, it can be pointed very quickly and the instant of firing indicated afterwards from the observing stations. In this way a very large number of guns can be concentrated from different batteries on a single vessel or group of vessels.

Electrical communication is utilized for range and position finding of various systems. Two general methods are in use, one having two observers at the extremities of a horizontal base line and another with a single observer placed at some height above the general level.

In the two observer method, the angles are measured and either plotted directly or are transmitted to a central station for plotting.

It is essential that this work shall be done very rapidly and accurately. To read the angles and then transmit and plot them involves loss of time and chances of errors in each step of the operation. Efforts have therefore been made to eliminate the necessity of reading the angles and to transmit and plot them automatically.

The Siemens apparatus may be considered a typical arrangement for this purpose. It consists of two parts used at what may be called the plotting and the auxiliary stations. A plane table, divided into squares, has a map of the harbor thereon. On this table is a telescope with cross-lines, carrying an alidade or straight edge; at a point repre-

senting on the map the other observing station, is a "step-by-step" electrical mechanism carrying a very light aluminum alidade or straight edge which is operated by impulses received from the auxiliary station; at the auxiliary station a box is placed containing a small hand dynamo and a telescope with cross-lines. The hand dynamo being worked, the telescope is moved to bear upon the target. If the instrument is in adjustment, the aluminum alidade at the other station will move with the auxiliary telescope, keeping parallel to it. The cross-lines at the observing station being brought upon the target, the location of the target will be at the intersection of the straight edge attached to the telescope, with the aluminum alidade operated in parallelism to the telescope of the auxiliary station. The track of a vessel can thus be continuously traced, the two observers simply keeping the cross-lines of their telescopes directed upon the vessel. It is necessary, of course, to make sure that both instruments are directed on the same point of the target. To this end it is necessary to have suitable means of communication between observers.

The method where one station and observer only is required is essentially a method of obtaining a location by polar co-ordinates. It presents many advantages over the two station system. It involves having the observer at a known height above the sea level which should, if possible, not be less than 100 feet, although fair work can be done with only 50 feet. The less the height the more important is it, to know and apply for correction, the height of the tide. It consists of a telescope mounted somewhat like a theodolite, with device for multiplying the movement in the vertical plane as the angles to be read are very small. It also has adjustment for different heights so that the range is obtained by direct readings, upon the cross lines being brought to the intersection of the target with the water. Having the horizontal angle from the horizontal limb and the range from the vertical angle, the position of the target is accurately located on the map. Major Watkins of the Royal Artillery, has invented one of this form of range finders, where the horizontal angle or direction of the target as well as its distance are automatically transmitted as many points as may be desired.

The details of this apparatus are kept a secret, the English Government having paid Major Watkins £25,000 and £1,000 annually for ten years. The value attached to an efficient method of range and position finding is thus tangibly indicated.

I think it possible that some of our own ingenious electricians could produce apparatus quite as efficient as that of Major Watkins. I do not, however, wish to be understood to belittle the ingenuity of the feat accomplished by Major Watkins. It is a problem not to be lightly approached. But I have sufficient confidence in our own skill to believe that we also could solve the problem.

Lieut. Bradley Fiske, U. S. Navy, has recently devised an electrical range finder which has much that is novel in that line and promises excellent results. I regret that I am not at liberty at present to divulge its method of operation. If it makes good the promise indicated from the preliminary experiments it will be of particular value for naval purposes, filling a place entirely unique and heretofore unattainable.

Electric lighting will be applied for ordinary illumination of permanent works as well as for special work of search lights. Not alone will this be true of permanent work but in operations in the field and in siege. The French have traction engines carrying the dynamo and search light for work of this character. As yet the experience of the military engineer is too limited to indicate that the arrangements of the electric plant used in fortifications will be very different from the ordinary requirements for civil purposes. Duplication or rather quadruplication of the plant of boilers, engines and dynamos will be desirable; they will be ordinarily placed, well under cover, probably some distance below the surface. This quadruplication of the working plant will be all the more essential should electric motors be adopted for manipulating the guns; should storage batteries become thoroughly serviceable, the extent of multiplication of the working plant could be reduced. The principal application of electric lighting for military purposes has been for the search light. This has not always been satisfactory. In some conditions of the atmosphere the search light does not reveal the position of the enemy, whilst it shows to the latter a very definite point at which to direct their guns. To avoid this the Germans have tried experiments of projecting the light upon mirrors some distance to one side of the search light itself. The destruction of the mirrors would be of less consequence than of the projectors, and could be quickly replaced.

Instances are cited where a vessel representing the attacking force was so illuminated by the search light that newspapers could be read, when 5,000 to 6,000 yards from the light, whilst the operators at the search light could not detect their presence.

The Mangin Projector is the form most commonly in use in foreign services and is assumed to be the best for our own service at the present day. Its essential distinctive feature is in the character of the reflector. This is a concave-convex lens with the concave side towards the light and the convex side silvered. The radii of curvature of the two surfaces are so calculated that the two refractions at the concave surface almost completely destroy all aberration, and this gain more than counterbalances the loss by reflection. The beam has a divergence of only 2°, being only 15 meters in diameter at a distance of 1,000 meters.

A small lens and total reflecting prisms fixed in a tube passing through the mirror enable the operator to adjust the carbons. The projectors are so mounted as to be easily directed by one man. They are made of sizes having reflectors of from one to three feet in diameter, the focal distances varying from 6.4 inches in the smaller size up to 30 inches in the larger. Experience in our own and foreign services indicate that hand regulation is preferable to the automatic regulation for the following reasons: Facility and rapidity of priming and lighting; possibility of instantly obtaining the required length of arc; the carbons can be withdrawn as much as the speed and power of the motor will allow and thus furnish the highest possible luminous intensity; independence of the apparatus of the movement of the projector or (if used on shipboard) of the ship; possibility of pressing the carbons against one another to remove excresences, and finally greater simplicity and certainty of action of the mechanism.

The potential for use with search lights need not exceed 50 volts and a working current of about 50 amperes seems to be desirable—a much greater current will heat the lamps and fittings to such an extent as to render it inconvenient to manipulate them.

It has been proposed by Major G. S. Clarke, Royal Engineers, to work a dynamo for electric lighting of trenches by horse power. This appears to me an excellent and perfectly feasible suggestion. The dynamo and horse power apparatus would be comparatively light and could easily be transported. Even in permanent works such an arrangement would find its uses. The ordinary horse treadmill might be utilized as the motive power for the dynamos.

The experiment about to be tried in New York harbor of buoys lighted electrically may have an important bearing in lighting up the approaches of a harbor and even in the protection of a ship from the attack of torpedo boats. This idea is due to Comdr. Mackenzie, U. S. N. A buoy of this character was successfully tested last winter in the vicinity of Robins Reef.

There is but little question that the electric motor will be largely used in manipulating guns and ammunition in lieu of power furnished by hydraulic machinery, steam or compressed air. In the case where either hydraulic power, steam or compressed air are used, injury to one of the lead pipes requires more time to repair the damage than when electrical power is used. In the last case the splicing of a wire, or replacing the broken cable by a spare one can be done with very little delay. It is proposed to to manipulate an 8" gun on the Chicago by electric motors. This experiment will be an important one and whilst some difficulties may be developed, at first, there can be but little question as to feasibility or ultimate success.

Thus far we have been concerned chiefly with applications of electricity which are also used in the arts of peace. We will discuss some which are more directly used in warfare. The vital element in the submarine torpedo and in firing guns electrically are the electrical primers. These have been evolved through many experimental stages, until finally one type appears to be generally accepted as the best.

From the limitations of this paper, and of your patience, I have avoided entering into details of development, because in most electrical matters you are thoroughly informed. But as the matter of electrical primers may be somewhat outside of the general experience, I will, as briefly as possible, state some of the salient features.

Three general classes of electrical primers are known and were used.

These are the high tension, medium tension and low tension.

In all cases we have two separate conductors, usually insulated throughout, except at the extremities. The ends are held firmly at a fixed distance apart by a plug of insulated material or by a tin clip. In the high tension primers, an igniting material of very great resistance is placed between the terminals. These are exploded by a condensed spark capable of jumping across the space separating the terminals. They are fired ordinarily by frictional electrical machines.

The medium tension differs from the high tension primer in that the composition placed between the terminals is of less resistance and may be fired by currents of a lower potential than that required for the

(*Continued on page 10.*)

SOUTHERN ELECTRICAL NOTES.

(Special Correspondence.)

The Manufacturing Company of Athens, Georgia, are arranging to put electric light machinery in their cotton factory.

The Electric Light Company at Durham, North Carolina, has agreed to light Parrish's tobacco warehouse, free of all charges, during the services conducted by Rev. Sam Jones.

The Cleburne Electric Light Company of Cleburne, Texas, has been chartered by E. M. Heath, C. W. Inerty and others, with a capital of $25,000.

The Planters' Oil and Manufacturing Company will erect an electric plant of 500 lights capacity, at West Point, Georgia.

At Columbia, Tenn., the Electric Light and Power Company has been chartered.

Just after the marriage of Mr. Harthon, one of the stockholders, the Electric Light Company, of Selma, Alabama, blew their whistle in honor of the occasion. The whistle was blown so loud and shrill that the turnkey thought there was a fire, and rang the fire bell which carried a large crowd to that ward, but the true cause was soon smilingly whispered.

C. Flangan, Superintendent of the Gas Works at Athens, Georgia, has petitioned the council to establish electric lights. The gas company want to establish the plant and has made a bid. Action will be taken on it promptly. EDWARD A. OLDHAM.

Charleston, S. C.

Exhibits at the American Institute, New York.

A striking exhibit, and one attracting general attention, is that of the Baldwin gas engine, a four horse-power engine, running a 32 light dynamo. For five hours of the day it charges a Julien secondary battery which, at night, feeds 52 incandescent lamps overhead; the dynamo, then cut off from the battery, itself feeding its 32 lamps, and thus there is a display of 84 lights, each of 16 candle-power, and all the product of the power developed by the little four horse-power engine. The secondary battery is placed upon a long shelf so that all can see it, at one side being the switches by which it is connected with the dynamo and again with the light series. The public are given also a close view not only of the dynamo, with which they may be said to be quite familiar, so far as appearance is concerned, but also with the means by which it is coupled up with the gas engine. And then the gas engine itself no less curious; the means of fuel distribution being one of these things that everyone guesses at without seeing and then find they are altogether wrong about.

Furnace grates or their relative economy no electric lighting men can afford to be indifferent about, for the maintainance of powerful engines are expensive affairs at best, and every item of practical saving helps to reduce the maintainance account. The Bannister rocking grate, as shown at the Fair, really deserves more of a notice than we can afford space for. By its use may be kept up a steady, free-burning fire and an even pressure of steam, desirable in themselves and always leading to a saving of fuel. The large amount of air space improves the draft and secures the most complete combustion, in many instances, because of these characteristics, one boiler sufficing where before two had been required.

—— In an interesting letter on "Flashed Filaments and Lamp Voltages," a correspondent suggests that if the makers of transformers were to wind the secondaries to give slightly different E. M. F.'s from the normal 100 volts now generally adopted, they would probably be able before long to buy better lamps at a cheaper rate. Our correspondent's views are based upon the idea that in the process of making unflashed filaments there will always be a certain number which deviate slightly on either side of the standard voltage, and that the makers will be unable to get rid of these lamps under ordinary conditions. It seems to us, however, that our correspondent addresses his appeal in the wrong quarter. If the lamp makers were from time to time to advertise the sale of so many thousand lamps of 98 or 102 volts at a reduced price, no doubt they would very soon find plenty of purchasers. Meanwhile, it is perhaps more important to insist on the desirability of using lamps of lower voltages in connection with transformers. We hope that the 100 volt lamp on transformer circuits will soon become a thing of the past.—*London Electrician.*

ELECTRIC LIGHT NEWS

—— Hotel Crosby, Waldeboro, Me., is to be equipped with gas and electric lights.

—— The Brush Electric Light Company, of Buffalo, have added 25 arc lamps to their plant.

—— The Brush Electric Company, of Baltimore, have recently made an addition to their plant of 25 Brush arc lights.

The Rutland (Vt.) Street Railway Co. is discussing the feasibility of adopting the electric motor, as represented in the Sprague system, for its cars.

—— Franklin, Mass., is much pleased with the workings of its electric lighting plant, and a local paper compliments the company on its efficient management.

—— The Minnesota Brush Electric Company, of Minneapolis, have recently purchased from the Brush Electric Company a No. 8 sixty-five light machine and current regulator.

—— Eastport, Me., is to adopt the steam heating system. The plant is being put in by the local electric company, and owners of twenty-two buildings and stores have already agreed to use the system.

—— Ten arc lamps have just been shipped by the Brush Electric Company, of Cleveland, to the Albany Electric Illuminating Company, Albany, N. Y. The Albany electric light plant is a very successful and well managed one.

—— The electric light plant of machinery has been received in Black Hawk, Cal., and a force of twelve men were put to work placing it. The company expect to have everything in readiness for the distribution of electric light to customers the first week in the coming month.

—— The electric light company at Newburyport, Mass., have received the commission from the horse railroad company to erect the poles for the equipment for the Merrimac branch with electricity. It is the intention to have the Newburyport and Amesbury line running by electric power before next July.

—— It is reported that the Augusta (Me.) Illuminating Company and the Thomson-Houston Electric Light Company, rival concerns, have combined, the former being absorbed. The terms of consolidation are not stated. It has been understood that one must succumb, as Augusta could not very well support two rival companies.

—— The question of lighting Fryeburg village, near Portland Me., by electricity is now under discussion. It is proposed to have the village charter amended so as to include the lighting of the streets as well as protection against fire. Power for running the dynamo is to be obtained from a mile or so away, and the expense of operation will be merely nominal.

—— The Malden Electric Company, of Malden, Mass., is now supplying the city of Malden with 80 arc lights and 254 incandescents, the town of Melrose with 26 arcs and 40 incandescents, and the town of Everett with 10 arcs and 80 incandescents. It also furnishes for business purposes to private individuals and firms 50 arcs and 600 incandescent lights.

—— The Buffalo (N. Y.) Electric Light and Power Co., operating 2,500 lights on the Westinghouse alternating system, has recently been testing the Westinghouse meter. As a result of this test the Buffalo company find they are enabled to compete with gas on an equal basis. A contract has just been closed with Mr. J. H. Gates, of the Westinghouse Electric Co., for two 1,500-light dynamos with the necessary meters. This company has also purchased three 150 h. p. Westinghouse compound engines.

ELECTRICITY OUR DEFENCE.

(*Continued from page 9.*)

high tension primers. These can, therefore, be fired by frictional and magnetic electrical machines or by batteries giving currents of high electro-motive force.

The low tension primer has its terminals connected by a fine conductor, called the "bridge," of greater resistance than the terminals. The passage of the current heats the bridge and ignites a priming which is placed around it. The current used may be of low potential but of considerable amount.

The high tension fuses were made with a resistance as great as ten meghoms whilst the medium tension varied from 100,000 ohm down to six or seven ohms.

The ignition of the high and medium tension fuses was effected both by the heating effect of the sparks or current and probably also by the electrolytic decomposition produced. This last is assumed from the fact that the current by which some of these primers were fired was so small in amount that the heat which could be generated thereby would not account for the ignition. Some would fire at as low a current as 0.03 micro-farad, whilst others would require as high as 16.00 micro-farads. The sensitiveness of some of these may be better appreciated from the statement that some high tension fuses could be fired under favorable conditions by a rubber comb, excited by being passed through the hair a few times. We can therefore easily conceive conditions where a man in rubber boots can fire charges prematurely, which are primed by such fuses.

To arrive at a definite knowledge as to the degrees of sensitiveness of various fuses in the market and to select suitable ones for service, Gen. Abbot, U. S. Army, devised a modification of the Cuthbertson Balance Electrometer. With this instrument it may be said that he practically *weighed* the charges of electricity with which the fuses were fired. He secured a large range of quantity of current, by using different sized condensers which were discharged, at will, through the fuses.

Finding that many fuses could be ignited with currents far below those appreciable to the human system, he ascertained by a number of experiments that without a condenser, 0.52 m. f. could not be felt and that 0.67 was the mean of the current which could be just felt, using condensers. He concluded from this that no fuse should be considered safe to use which required a smaller current than 0.8 m. f. to fire it, such a current being distinctly perceptible. He found a fairly reliable fuse which could be fired at about 2 m. f. and this he placed as the maximum limit of current for a service fuse.

These investigations tended to show definitely the class of fuses which were supersensitive, and which could be considered safe. Manufacturers ceased to make the former and it is claimed that the number of accidents in blasting and mining operations were very much reduced thereby.

Further investigations showed that the best of the high and medium tension fuses were of a variable character as to the resistance and sensitiveness—changed and deteriorated with age or when subjected continuously to very feeble currents used in testing—and that no previous tests or measurements would surely indicate whether a given fuse would fire when required to do so. It was essential to a system of submarine mine which might be in place for many months, that the condition of the fuses should remain constant and their serviceability could be ascertained at any time by measurement. For these reasons Gen. Abbot decided to adopt the low tension fuse to the exclusion of the other two. He had arrived at this conclusion whilst the authorities of other countries still clung to medium tension fuses.

He then entered into investigations to decide upon the details of the low tension fuse bridge, giving the best results. It was necessary to determine the kind of metal to use in the bridge and its diameter in length. It was desirable that the metal to be used should be non-corrodable. These conditions fulfilled, it remained to have as high electrical resistance and low specific heat as attainable. The conditions as to permanency of character and ductibility excluded metals, such as lead and bismuth, which fulfilled in a high degree the other conditions.

These considerations lead to the selection of platinum-iridium, natural alloy, not easily corroded and having a higher resistance and lower specific heat than pure platinum.

He selected a wire .0025 of an inch diameter but it is not very clearly stated why this rather than a somewhat smaller size was selected.

It was desirable to have the primer of the least resistance consistent with obtaining explosion rapidly using a moderate current. Where the bridge is very short, the heat is conducted rapidly by the large terminals and explosion is delayed. Where the bridge is too long a larger current is required, owing to increased resistance. From experiments made seven-thirty-seconds of an inch was selected as the greatest length which could be used without increasing the resistance too much. This length would of course be somewhat different where a smaller size wire were used.

It is with fuses of this general character but with finer wire that the shell fired from the pneumatic gun is exploded.

The problem to be solved was of somewhat different character from that involved in the ordinary torpedo. For reasons to be mentioned hereafter, it was necessary to know the *time* requisite for exploding the primer and to produce one giving, for a stated fixed maximum current available, the minimum time. It was a struggle wherein the subject of contention was the one-thousandth of a second. It was found a difficult matter to devise apparatus which should be so delicate as to record the small fractions of time involved, whilst it should be strong enough to withstand the severe shocks arising from the violent explosions of fulminate of mercury primers. Nor was this work devoid of danger. Mr. Birnie C. Batcheller, a graduate of the Massachusetts Institute of Technology, my assistant, arranged the apparatus and carried on the experiments from which these curves connecting time and current were made.

Mr. H. Julius Smith aided me very materially in these experiments, varying in every desired way the character of the bridge, ringing changes upon the diameters and length of wire and of the priming used. The success of the entire system rested upon the integrity of a filament only one-thousandth of an inch in diameter. I feared that the "set-back" of the surrounding priming might break the delicate bridge. Mr. Smith therefore assisted me in producing a bridge which was solidly imbedded in a pellet of compressed powder. This was difficult of attainment in view of the pressure required and the delicacy of the bridge which was to be imbedded in the midst of the compressed priming. The bridge protected in this way makes it possible to use the electrical fuze in ordinary powder gun shell.

It is popularly supposed that a defence of submarine mines is one that may be easily improvised without specially trained personnel, and is, in itself, sufficient to render a harbor practically invulnerable. But this is very far from the fact. It is complex in character, requires the greatest care in the preparations of the material and in the training of the personnel to manipulate it. Every detail must be carefully prepared—there must not be a single weak link in the chain or the system is likely to fail. It is not desirable to so close the entrance to harbors as to prevent passage of our own ships, either way. The system must, therefore, be such as to be operative at will. In trusting only to judgment firing the enemy may, at night, attempt to run the blockade through the fields protected by the torpedos. It is, therefore, necessary to be able to set them so as to act automatically, and, in addition, give warning to the guardians of the harbor that attempts are being made to enter. As an adjunct to this defence, guns of shore batteries may be directed so as to strike different portions of the harbor; these are to be fired when the enemy's ships arrive at the predetermined points. The firing circuits of the guns are closed when the ships strike the buoys containing a suitable device for this purpose.

It is only by the aid of electricity that all this can be accomplished. You will readily perceive the necessity of a trained personnel. The Engineer Battalion is the only force that we have for this work. In addition to the officers of the Engineer Corps of the army, a few officers of artillery have received instruction in submarine mining. To place mines required in all of the important harbors of the country as quickly as may be necessary will require a very much larger force than that available from the regular army. A fair proportion of this force must have technical knowledge with reference to electrical appliance. It will therefore be necessary for you, gentlemen, and other electricians of the country to assist. In England an auxilliary volunteer torpedo corps has been formed to assist the regular forces. They are practiced annually under the direction of the regular engineer officers, who are charged with the torpedo defences. Why should not this be done in the United States. Once give your attention to these matters and I look to improvements in means and methods. I do not desire to detract from the character of the work already done by Gen'l Abbot and other distinguished officers of the Corps of Engineers of the army, in devising the present system of torpedo defences. I believe that we have led the way in many essential matters. But it is much to assume that the "ne plus ultra" has been attained. We know the great advances made in electrical science and its practical applications, emanating from your ranks. Other advances in the direction of torpedo appliances will certainly follow when your attention is given to the work.

The high explosives used for submarine work should possess great volumetric explosive energy combined with stability of character. They should be unaffected by moisture or by cold. Gun cotton, explosive gelatine and some of the dynamites appear to fulfill these requirements to a greater or less degree. It is very rare to find a single agent fulfilling all of the requirements.

The relative energy of standard explosives for submarine work, for equal units of weight, has been determined by Gen. Abbot to be as follows:

Dynamite No. 1	1.00
Nitro-Glycerine	.81
Gun Cotton	.87
Explosive Gelatine	1.42

Whilst moisture and alternate freezing and thawing have been supposed not to affect gun cotton, it is still an open question; there are instances where the gun cotton has been found deteriorated when wet and alternately frozen and thawed. Besides this it requires a detonator of perfectly dry gun cotton to produce its maximum effect. It will be seen that where a mine is to be under water for a considerable time it may be difficult to secure this detonator from moisture.

Gun cotton is generally accepted in foreign services as being the safest to handle and most stable, whilst in our own service dynamite No. 1 is preferred.

But dynamite No. 1 will, if remaining undisturbed for any length of time, give up its hold on some of the nitro-glycerine which it contains in suspension. And this once separated is both dangerous in manipulation and is more liable to change and decomposition.

Explosive gelatine has, so far as my own experience goes, fair stability of character, is not affected unfavorably by moisture or frost and is of very high density. This last is 1.6. With its very high relative energy, it gives the very greatest energy per unit of volume of any explosive known. Comparing it with dynamite No. 1, its volumetric energy is 189 to 100; compared with dry gun-cotton it stands as 263 is to 100, or two and five-eighths as great. Explosive gelatine is more insensitive to shock than dynamite, and hence is in less danger of being exploded by countermining operations.

It may be well to mention here that all of the high explosives are capable of a number of orders of explosion depending usually on the character of the initial detonation. A very wide difference of results may be obtained. It is therefore essential that the initial detonation should be violent in character. In addition to this, a certain degree of confinement of tamping adds materially to the power of the explosion. The more insensitive the explosive, the more important is it to have confinement of the charge and powerful initial detonation.

By experiments on an iron pontoon, representing the double cellular bottom of an iron clad (the Monarch), Gen'l Abbot determined that an explosion producing an instantaneous pressure of 6,500 lbs. per square inch would be fatal. He also deduced formulas by which the pressure produced by different explosives can be computed.

It is thus possible to predict the danger radii of different classes of torpedoes.

The following is the range of destructive action of Explosive Gelatine, Gun Cotton and Dynamite No. 1:

	100 lbs.	200 lbs.	500 lbs.
Explosive Gelatine	20 feet.	28 feet.	44 feet.
Gun Cotton	14.7 "	20.5 "	30.7 "
Dynamine No. 1	16.3 "	29.6 "	35 "

It is seen that the charges must be exploded comparatively near to the target to produce fatal results. But serious injuries will result even when the explosions are much farther from the vessel.

A shock incapable of disrupting the bottom would still be sufficient to injure the rudders and propellors rendering the vessel useless and helpless. Injury to the boilers and engines are also likely to ensue.

Whilst the standard charges provided for in our service have been comparatively small we find those in foreign services to be as great as 900 lbs of gelatine giving an effective striking radius of 90 feet. The same torpedo charged with 600 lbs. of gun cotton would have an effective radius of only 45 feet. The advantage of using the more powerful explosive is here clearly indicated.

Two general classes of submarine fixed lines are used; floating or buoyant mines and ground mines. These again may be entirely automatic in character or may be made subservient to the will of the operator on shore.

The buoyant mine cases should be as light as possible and yet be sufficiently strong to withstand the explosion of mines in the immediate vicinity, as also to resist the countermining of the enemy. The shape must be such as to have the maximum volume for a given weight, and at the same time, offer as little resistance as possible to the action of the tidal currents. It should be rendered impervious to water.

For ordinary conditions the spherical form appears to be best adapted for this purpose, but it had been considered difficult to manufacture. This, however, has been accomplished by the Continental Iron Works of Brooklyn, so that the two hemispheres of low steel are actually welded together and making a complete sphere. These mines must be accurately placed securely anchored, so that they shall remain from ten to fifteen feet below water. They must never be visible at the surface; where the rise and fall of the tide are very considerable, special arrangements must be made to provide for this, so as to retain them within touch of the enemy's ship's bottom, at high tide.

The ground mines may be of cast-iron as weight is not detrimental. It is usually of a hemispherical shape which is favorable both as to its strength and ability to resist countermining and as to its holding its place against the action of tidal current. When it is to be set for automatic action, it requires an auxilliary buoy carrying a circuit closing attachment which is also used in the buoyant mine.

The circuit closer is of such character as to either signal the presence of the enemy when in contact with the buoy or mine containing it, or to explode the mine automatically should that be the wish of the operator. It must, furthermore, be of such character as to permit the firing of the mine at the will of the operator independently of any contact of the enemy. All of this is possible with the form in use in our own system as well as in those of others. I am not at liberty to go into the details of this interesting part of the mechanism. But I doubt not that many here could, if called upon, devise something that would answer the purpose.

This and other interior arrangements of the torpedo are of such character as to permit the operator to inform himself at any time of the condition of the fuses, and indeed, of the interior of the torpedo as to leakages.

The operating torpedo chamber is so placed as to preclude the possibility of injury to the controlling apparatus of the system. This apparatus conveys information to the operator when the enemy has struck a torpedo, and if set for automatic action, whether it has been fired. It enables him to render the torpedoes innocuous to our own vessels at one instant and cause them to act effectively at the next against the enemy. Information is transmitted from range and position finding stations as to the position of the enemy so that he may select the instant when a ship is over a mine or group of mines, to fire them by "judgment." As "judgment" firing requires greater latitude, to allow for errors as to exactly locating the enemy, in our system, groups of three are fired in this case.

And here it may be well to indicate the general arrangement of a group of torpedoes.

These are usually in grand groups of 21, divided into smaller groups of three. The arrangement will be made clearer by this diagram. The system is based on the use of a multiple cable of seven cores. The cable is separated in the manner shown, by means of a grand junction box, and carried therefrom to seven triple junction boxes. At these three single conductors are connected to the core from the main cable and carried to three torpedoes placed as shown. The torpedoes are placed 100 feet apart. At this distance the cases are supposed to be strong enough to withstand the shock of explosion of a neighboring mine. Should any of these be struck by an enemy, it will either be fired or signal the fact of being struck to the operating chamber. As the explosion of any single torpedo, or group of torpedoes, would leave a bare end of wire in the water, making a notable "earth" connection, an arrangement called a cut-off is placed in the junction box, through which the current must pass in firing the mine. This "cut-off" consists essentially of a fuse similar to the one in the torpedo, except an exploding charge is used just sufficient to break the "bridge." This is in a small strong chamber, suitably provided with stuffing boxes through which the cable enters and passes out; when the cut-of fuse is fired there is a complete break within it, between the main lead wire and the branch leading to the torpedo fired. This break is in the water-tight case. Hence the making of an earth is avoided.

A method of avoiding the use of heavy multiple cables has been devised by Capt. McEvoy. This requires only a double conductor leading to a junction box. In this there is a step by step movement, connecting the main lead wire through which the firing current may be transmitted, to a single lead wire passing to each of the torpedoes of the group. One of the conductors of the main cable can be comparatively small for the signalling work, so that the entire cable to be used may be very light. The arrangement is such that no cut-off fuse is required to avoid an earth. The operating box has a dial showing the torpedo on which the connection is made.

Another system may be made where the junction box contains the firing battery and a step-by-step movement which is actuated by a signalling current brought by a very light conductor from the shore. This changes the contact to any torpedo of the group. Reversing the current changes the polarity of a small magnet which, acting on a permanent magnet, brings the firing current into play in the torpedo connected up for firing.

As in all operations of war there is a reverse side to the question of the efficiency of protection afforded by a system of submarine

mines. The enemy will be sure to countermine. This may be done in various ways. A launch directed automatically by electrical devices, can be made to tow a series of counter-mines into position,anchor them and be withdrawn. The counter-mines can then be exploded electrically. Advantage may be taken of the tidal current to either move counter-mines into position or to work drags to pull up the mines of the defence or to derange them. Divers may be resorted to for cutting the conducting cables, either directly or by placing small charges thereon, which could be afterwards exploded. The electric light can be efficiently used in submarine work to assist the venturesome explorer in this work.

And last but not least, the pneumatic gun which I shall speak of later, affords the most effective way of countermining.

In view of the possibilities of countermining, the mines must be placed so that they are under the effective fire of some of the shore defensive works. This and the difficulty of accurate judgment as to their position with reference to the enemy, renders it undesirable to place the torpedo fields more than two miles beyond the defensive works. On account of smoke, fog, etc., it is not considered well to exceed one mile from the observation stations.

Briefly, the torpedos are ordinarily placed in several irregular lines or groups, most thickly in the middle of main channels, and more thinly in waters navigable for smaller vessels.

In shallower water ground mines are mostly used ; in deeper waters the buoyant mines are used.

The English custom is to use buoyant mines in waters exceeding 70 feet.

There are two kinds of fish torpedos—movable mines—in general use. One, the Sims electrical torpedo, where the motive power is generated on shore from a dynamo and a motor in the torpedo itself made to reproduce this power and propel itself. The torpedo is kept suspended a given depth below the water level by a float, and it is directed by means of flags on the float from the operating chamber. Whilst the torpedo is efficient in some ways, it is very much lacking in speed, the maximum speed having been developed so far being only about eleven miles an hour. In view of the fact that modern ships will go from 18 to 20 knots an hour, it is to be seen that the times when such a torpedo could be used are not as frequent as they might be.

There is still another form which resembles this very much, called the Patrick torpedo, in which the motive power in the crank goes in a leverage form in a cylinder arranged so that it may be emitted and heated and working a little motor. It is steered electrically from the shore and is fired in the same way. The motor is set going, is stopped, the speed is changed by the electrical appliances operated from the shore, being connected therewith by cable. One of the great difficulties with the Sims torpedo is the weight of cable required, its resistance in passing through the water, and a limitation as to the current which can be passed through where you can pass a small cable. I may say here that these fish torpedoes cost from $7,000 to $12,000 each, have a range of two miles at most, and must be seen at a distance to be operated successfully. The difficulty with this you will readily perceive when you bear in mind that very little of the float is visible. and in case of rough weather, fog or smoke, conditions which are likely to exist in time of action, it is next to impossible to direct them. Once fired that is the end of them. If they have run their course without having succeeded in reaching the enemy, they are of no further use.

Mr. H. A. Reed: Will the lecturer give the speed of the Lay torpedo?

The Lecturer: The Lay torpedo has given the highest speed that has been known thus far, which is, I think, 21 miles. They were to attain 20 miles and tried a great many experiments, falling just short of it ; but recently they have succeeded in getting 21 miles. That is, I think, the best of the torpedoes at present available.

Inasmuch as the shell of the pneumatic gun is fired electrically, I thought it might interest you somewhat, and have brought with me some specimens of the batteries and the fuses. The problem that met me at the outset of the experiments was to make a fuse that should be sensitive when desired, and safe at other times. It was also necessary for me to produce the explosion of the shell not at the front end but in the rear end, and it also became evident to me that the time might come that I would require a number of points of simultaneous ignition. After experimenting largely with ordinary fuses I gave the thing up. I found the ordinary percussion caps were at times supersensitive and at times almost unable to explode them. It then occurred to me I might use electricity in exploding primers, and I at once commenced making experiments, trying at first ordinary batteries of considerable size, but finally striking upon the Glory, a sulphur battery, being assisted in the work of developing the battery necessary for this, and making the battery small and compact, by Mr. John A. Barrett. In my first experiments, the first experiments in which the electrical fuse was used, I had no means of breaking the circuit. At first the battery was made with a solid platform intervening between the zinc plate and the sulphur. Different salts were used, but all were found in time to become more or less active by absorption of moisture. On one occasion I loaded some shell and the batteries. The arrangement I then had was that the batteries were placed inside of the shell. Of course I took every effort to keep out moisture, but it happened to be in a very moist time. The weather was very damp, and on putting the telephones to the telephone terminals I found the batteries were unpleasantly active, due to the absorption of moisture by these salts. That being the case experiments were tried with the battery without salt, and the battery was made as you see it in my hand, and so effective is it that a battery as minute as this that I have in my hand was sufficient to ignite a primer, bringing the bridge to a red heat. In the first experiments the batteries were wet when being used and I trusted to the striking of the target to the closing of the circuit. But it was also desirable to make the shell so that it would explode in striking the water, so that when the shell missed the ship the explosion should take place—perhaps near enough to the vessel to destroy it. I resorted to a dry battery so that after it left the bore of the gun it would require simply the wetting of the battery, so that with the wet battery in the shell prepared to act when the shell strikes the target above the water, and with the dry battery prepared to explode when it strikes the water we are prepared to produce the explosion, hit or miss.

One of the difficulties met with in the development of the fuse was that at first having had some failures, knowing that all the arrangements were perfect, it was difficult to account for it. But upon firing one of these batteries in an iron tub it was found that the water entered the case too forcibly and the batteries were broken up. In order to avoid this, an interior diaphram was placed with a central hole, so that the water in entering would have to go around the corner. Then another problem presented itself to notice. On ship board with the shell in the gun and the dry battery in front it was feared that the water entering the barrel in rough water would make the battery active, and in order to avoid that other experiments were made which developed this arrangement so made. that the opening through the battery is entirely closed until the shell strikes the water. We found we could make the spring stiff so that the entire gun barrel could be used without opening. We wanted to get a greater current and in order to do that a double battery was used, the inner battery being wet, but the outer being dry. There is no current generated of course, the batteries being in series, and this battery became wet when you got the current of both batteries.

There was still a further problem connected with it, owing to these failures that I spoke of in the earlier stages of the experiments. I desired to make assurance doubly sure, so that there should be no unexploded shells lying about in the channel, and thereupon I put another dry battery in the rear, but the difficulty in arranging that was that a large amount of moisture was discharged in the air, and this cap was put in when the air pressure came on to force the shell out—I would say further there is a spring in here which tends to push this cap on. This being the rear of the shell when the air pressure comes on it those flips fly out ; but as long as the air pressure remains on this is held in its place ; but as soon as it leaves the bore of the gun it drops off.

As I have indicated in speaking of these experiments it was necessary to get a very considerable current in order to fire as fast as I wished to. In the first experiments made with firing shell against iron plates, I found that the explosion of dynamite produced very little result, and that rather surprised me, because I knew that there was sufficient energy in the explosive to do a great deal of injury. It occurred to me that the question of time came into play and that the excess of that rather protected the plate than injured it. I arranged some experiments so that the circuit closed before the impact could take place. the charge itself being separated from the shell by cotton waste. The result was that whilst a shell loaded with dynamite exploded from the front end only perforated one plate, a shell loaded with sand would perforate three plates, and the shell exploded from the rear end electrically perforated six plates, showing the importance of igniting the shell from the rear end and the importance of this very small element of time.

I have taken up so much more of your time than I had anticipated that I will run over quickly some of the views of pneumatic guns and submarine explosions, and will be ready then to answer any questions you may care to ask in the matter. (Applause.)

[A number of interesting views were exhibited and described.]

We have here the original two inch gun which was brought for experiment to Fort Hamilton, for the initial experiment. You will see it is very simple in character, a mere tube of brass mounted on a key rail.

Mr. Hamilton: How large is that?

The Lecturer: That is two inches in diameter and 28 feet in length. It was connected with the reservoir by a flexible hose and air was admitted by an ordinary cock. Mr. Milford first tried gunpowder and made an arrangement by which a small charge of gunpowder would set the shell going, and then pull a lanyard and explode another charge ; and it ended in bursting the gun. He afterwards tried some other experiments at Sandy Hook with the same result. Afterwards the four inch gun was built, the valve and other mechanical details being designed by Mr. George N. Reynolds, then of the Delamater Iron Works. Whilst that showed the feasibility of the method of throwing high explosives, it had not gone far enough. The charges thrown were too small to be of any practical value. The next thing was the eight inch gun. It was with this gun that the experiments were tried with which the "Silliman" was blown up. You see a photograph there taken probably the first time a shell was fired from the gun. A photographer happened to be there, and by good fortune he happened to catch the shot just as it was passing out, as you see here. That has since been repeated by Major Randolph in my regiment. You see here a shot caught in the air. This apparent smoke is a little moisture that is so condensed upon the firing and disappears almost instantly. There is still another one that gives a little better view which I will show. You see here the shot is caught quite distinctly. (Showing another view.) The velocity was a little lower on that occasion because we had taken off one gun-barrel in order to determine the effect of range on shortening the barrel, and Major Randolph did this without any electrical attachment to the gun, but simply standing with his back turned to the gun, being accustomed to the sound of firing and knowing when to open his camera and doing it almost instantly. The initial velocity of a shot was about 600 feet in that case.

We now come to the experiment of the "Silliman." The Secretary of War wrote the letter to the gun company asking what we could do, whether we could destroy anything or hit anything. The letter being couched in rather doubtful terms, the answer was that we could destroy any vessel then existing in the U. S. Navy at the range of one mile ; that if any more powerful vessels were built we would contract to destroy them, provided we were given a chance to experiment before hand ; that we would prefer as an experiment, if experiments were determined upon, one of the monitors, as being the best test we could have for showing most fully the power of the gun. There were some doubts expressed by some of the officers who were concerned in the experiments as to the accuracy of the fire and as to the torpedo effect producible. The accuracy of fire was shown by a series of experiments, five out of six shots being landed in the same spot. Previous to these experiments with the "Silliman" there was so much doubt as to the accuracy of the apparatus that one officer offered to sit on the target when the gun was fired. (Laughter.) The target was a very small one, a vessel only 80 feet long and 20 feet wide, and at the distance of a mile it looked pretty small so that it was not an easy thing to hit or to sink either, although it was a wooden vessel, because there was no ballast in it. The first shot was exploded short of the vessel, as it occurred to me that if I struck it the first time it might be considered an accidental shot ; but that explosion shook the vessel up, brought down the mainmast, and changed her bearing with reference to the line of fire. There was only one mast remaining. I then pointed the gun directly at the ship. An officer representing the Navy Yard there present looked through the telescope so that he could see where the gun was directed. The gun was directed accordingly, and my intention was to go shortly underneath in the middle and break her back. I may say here that so confident was I as to the accuracy of the gun, that when I was telling two persons the experiments which I intended to do, I stated that I intended to shake her up by the first shot and break her back at the next, and then destroy what was left. That was cousidered boasting ; but it was exactly what I was fortunate enough to accomplish. The next shell struck slightly short, and went under her and broke her back, the pieces of the vessel rising. This view was when the water was coming down, apparently ; it was caught by the photographer at the instant when it was coming down.

The next shell that followed was on the chamber above and exploded above water, and another one went in the same vicinity, I followed it up after the ship had sunk, because I wanted to indicate beyond question that I could put my shot where I wanted it, time after time, and that it was not an accidental matter.

[A number of views of war ships were then given, also other torpedoes.]

I apologize, gentlemen, for keeping you so long, and I shall be very glad to answer any questions after the meeting is over in regard to any subjects of inquiry which may have arisen in your minds. (Applause.)

Mr. Jarvis B. Edson: I would like to tender a vote of thanks to the lecturer for his very interesting lecture, and I make the motion for that purpose. Unanimously carried.

Dr. Otto A. Moses: When you were speaking of signalling stands, and suggested that a triangular arrangement might be devised, and the central point which seemed to be a point to fix the attention of the gentlemen, was the light to be constantly burut?

The Lecturer: That was my intention.

Dr. Moses: Was it to be of the same color as the other?

The Lecturer: Not necessarily, but higher, to test from it so as to have the light on one side or the other. I can easily imagine, one light being extinguished, that the observer would not know what is left ; but if he had a reference point above he could tell definitely. You can see readily that where two lights are on the same level, that in the dark it would be difficult to tell, when one had disappeared from view, which was left.

Dr. Moses: Would not perhaps a circular arrangement, something like a circular saw, larger than the torpedo itself, be of advantage in traversing nettings?

The Lecturer: It might probably be useful, moving in the same plane as the torpedo, yes. As it is, however, these torpedoes go with so much force that they usually break up the netting. The object of the torpedo is essentially aggressive, and when it once gets at the enemy it is not apt to withdraw. Besides that, there is not much time left. It is very difficult for the operator to distinguish when it is struck and reverse the operations and bring it back.

Dr. Moses: My reason for drawing you out on this point is to call to your attention the fact that there is now in existence a motor which I have had the pleasure of seeing reversed from 2,300 revolutions a minute in three and a half seconds.

The Lecturer: It is a question of a very small fraction of a second.

Dr. Moses: This would be almost instantaneous.

The Lecturer: It is possible that it might be made to work, but it would require a very delicate mechanism, I think, although I do not say that it is beyond the range of possibility. The question is whether it would be worth while.

Dr. Moses: This range of 90 feet that you speak of as being the greatest operating distance, there is no considerable effect beyond that range of 90 feet?

The Lecturer: Oh, yes, at 90 feet it would break in the bottom of the ship ; at greater distance it may not break in but it may disable the machinery.

Dr. Moses: In guiding your movable torpedoes at night what arrangement do you make?

The Lecturer: They generally have lamps, shaded on the side towards the enemy. They are supposed not to be visible to the enemy, but visible to yourself or the operator. That is practically the case. It would be very difficult to detect the approach of anything of that kind, but, of course, the lights would not be very brilliant, and in hazy weather after they are off three-quarters of a mile it is very difficult to detect them sufficiently to direct accurately.

Dr. Moses: One final question ; these electrical bridges that you speak of as having such constant resistance, how were they joined?

The Lecturer: By a machine which I have mentioned, devised by Mr. Smith ; it is done automatically. He uses ordinary heat for that, but it is done automatically, as I said, at the rate of 7,000 to 10,000 a day. (Applause.)

Mr. Edson: Do I understand that the arrangements commonly used are not of rope or fibrous material, but of metal?

The Lecturer: It is a wire netting supported by booms usually. The torpedoes do have very considerable momentum, and some have been said to cut their way through; and in some of the experiments with the Sims torpedo where booms were placed as obstacles, this cut-water that you saw extending above the torpedo assisted to dive under the boom and the motor developed some power when it met this resistance and halted there a moment and dived under without any arrangement on the part of the operator.

Mr. Edson: By using a wire of considerable tensile strength as is possible with some of the finer grades now, it might offer considerable resistance to a vessel particularly if placed at very considerable distance?

The Lecturer: Yes, it is the only way of stopping these torpedoes, but they generally meet that by sending two torpedoes, one exploding there and leaving the other to follow it. The two are connected, one exploding on striking, the other being far enough away not to be affected by it, and then entering the netting.

ELECTRICAL PATENTS

(Copies of any Patents in the following List will be sent to any address on receipt of twenty-five cents.)

INDEX OF INVENTIONS FOR WHICH LETTERS PATENT OF THE UNITED STATES WERE GRANTED IN THE WEEK ENDING OCTOBER 8, 1888.

391,010 Electric meter; Harry Bentz, York, Pa.

391,070 Dynamo electric machine; Myron W. Parrish and William R. Cole, Detroit, Mich., assignors to the Parrish Bros. and Peck's Electrical Company, same place.

391,224 Hand magneto electric machine; John B. Blair, Chicago, Ills., assignor to J. B. Blair & Co., same place.

391,229 Separator for electric batteries; Herbert W. Butler, Briston, County of Surrey, England, assignor, by mesne assignments, to the Electrical Accumulator Company of New York.

391,270 Dynamo electric generator; Gustav Pfannkuche, Cleveland, Ohio, and Alfred Pfannkuche, Exeter, N. H.

391,285 Cloth cutting machine; Albin Warth, Stapleton, N. Y.

391,319 Regulation of electric motors; Lander S. Harris, Detroit, Mich.

391,351 Electrical switch; John S. Anams, Indianapolis, Ind., assignor to the Jenney Electric Company of Indiana.

391,356 Telephone transmitter; William H. Collins, Chicago, Ills., assignor of one-half to Jacob Kirkner, New York, N. Y., and Robert Bines, Chicago, Ills.

391,394 Electric railway system; David G. Weems, Baltimore, Md.

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1 N. Y. Safety Engine, 12″x12″, 60 H. P., 6 years old.
5 Ball Engines, 10″x12″, 60 H. P., 4 years old.
1 Westinghouse Engine, 9″x9″, 50 H. P., 4 years old.
1 Payne Engine, 8″x10″, 35 H. P., 5 years old.
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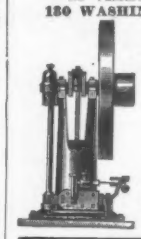
18 VESEY STREET, NEW YORK.
180 WASHINGTON STREET, CHICAGO.



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Opp. Willard's Hotel. WASHINGTON, D. C.

NOTICE TO THE TRADE.

The injunction restraining me from the manufacture and sale of *PORCELAIN* electric burners for multiple gas lighting, obtained by A. L. Bogart in a suit instituted by him for an alleged infringement of Patent 119,561, *HAVING BEEN DISSOLVED BY REASON OF THE EXPIRATION OF THE SAID PATENT,* I am now making my latest burner of *PORCELAIN* as well as of *LAVA.*

My *FRICTIONAL ELECTRIC MACHINES* embrace the latest improvements in construction and design, and are the only ones now offered to the trade that are protected by *existing* letters patent.

CHARLES H. HINDS,

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418 W. 27th STREET, - - NEW YORK.

SILKS. Full assortment of different sizes and qualities on BRAIDER SPOOLS, ready for the machines, in Red, Yellow and Green. Other colors to order. Send for Sample and Prices.

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FRESH TESTIMONIALS TO THE SUPERIORITY OF

SIMPLEX WIRE.

THE VIRGINIA ELECTRIC LIGHT & POWER COMPANY, OF RICHMOND, VA.
NEW YORK OFFICE, 63 WALL STREET.
New York, August 21st, 1888.

A. F. MASON, Esq.,
SIMPLEX ELECTRICAL CO.,
Boston, Mass.

Dear Sir:

I have been using the Simplex Wire on a large portion of our lines in Richmond, Va., for the past five months. I have taken daily tests of the insulation during that time. The longest single circuit I have is about five miles, and at no time has the insulation test ever been less than one megohm. I cannot speak too highly of the wire or its insulation. A large portion of it has been run through foliage and trees in the streets, and upon examination a few days ago I failed to find any place where the wire has been abraded by coming into contract with the branches of trees. My instrument does not measure over one meghom, and I cannot tell how much higher the insulation may have measured. One megohm on wires in circuit is enough for me.

Yours very truly,
W. H. COLE, *Superintendent.*

THOMSON-HOUSTON ELECTRIC CO.,
AUGUSTA, GA.
August 12th, 1888.

Dr. A. F. MASON,
SIMPLEX ELECTRICAL COMPANY,
328 Washington St., Boston, Mass.

Dear Sir:

We are using in our arc-lighting circuits about twenty (20) miles of your Simplex T. Z. R. wire.

We have feund the insulation a most perfect protection against moisture and the abrasion of small tree limbs.

Have used your wire in our station, for running through trees, on buildings and porches, under mouldings, etc., and through cellars, and we have never been able to discover a "ground" upon any circuit since our plant was put into operation.

Very truly yours,
JOHN H. WATERMAN.

ADDRESS,

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328 WASHINGTON STREET, BOSTON, MASS.

EUGENE F. PHILLIPS, PRESIDENT. W. H. SAWIER, SEC'Y AND ELECTRICIAN.

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SUPPLEMENT

To the ELECTRICAL REVIEW, October 27, 1888, Containing Illustrations of the Westinghouse System of Electrical Distribution for Light and Power, etc., etc.

THE WESTINGHOUSE SYSTEM
OF
Electrical Distribution for Light and Power.

(*Continued from page 1, Regular Edition.*)

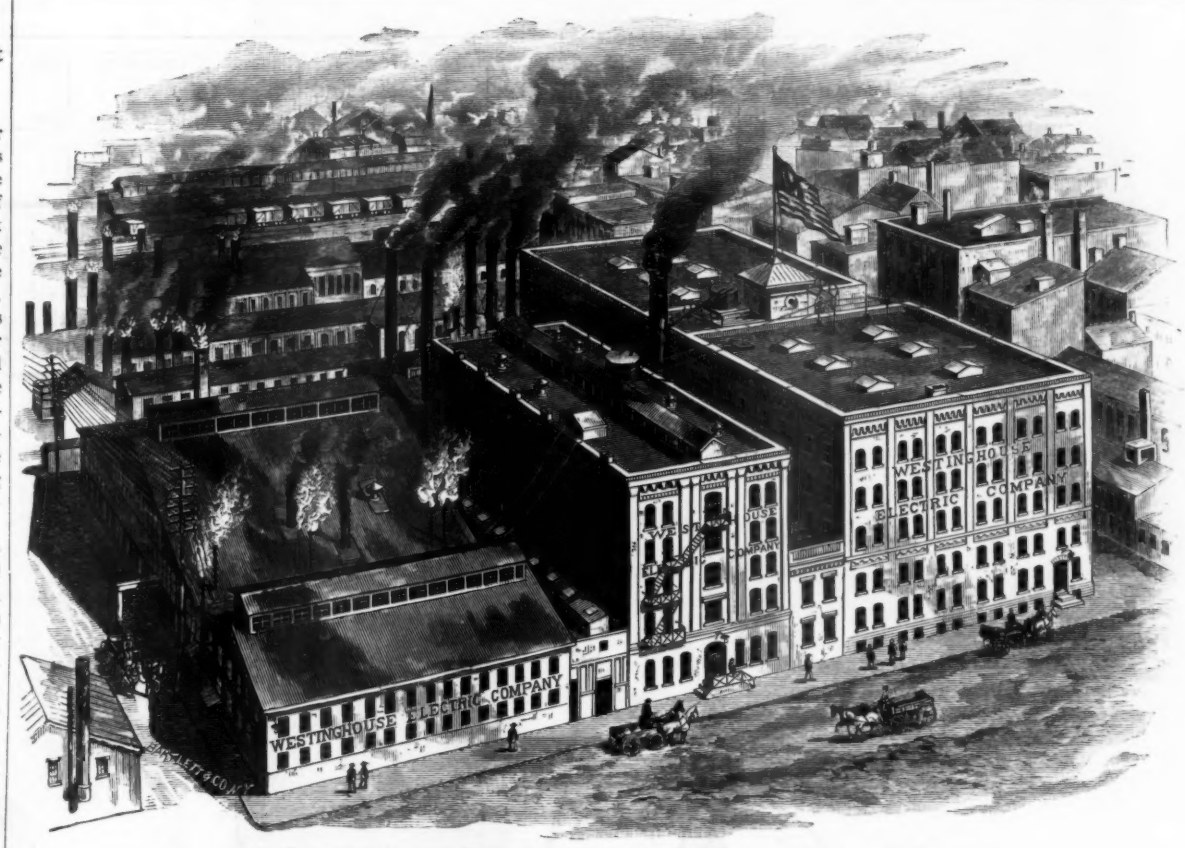
so, and very little current passes either through the armature or field, but as load is put on and the work increases, the armature tends to lag slightly, causing the passage of more current in proportion to the work done. The reaction between the armature and the field is similar to that between the primary and secondary coils of a converter, and the increase of load on the motor causes increased supply of current in a manner exactly as takes place when lamps are added to the secondary-circuit of a converter. The addition of the return wire for the motor circuit can be made easily so as to adapt existing lighting circuits to motor work, and the armature of the dynamo used for driving motors is equally available for lighting purposes.

By an ingenious adaptation of the converter principle, this motor may be regulated in speed and reversed in its direction of motion without the use of switches or resistance coil. The method of operation is exactly similar to the link reversing gear of a locomotive. The extreme position of the reversing lever in one direction corresponds to full speed ahead, from which it can be graduated through every shade of intermediate speed to the reversing point, and from that on to full speed backwards. This is more readily accomplished owing to the absence of brushes, since there can be no sparking or wear due to the passage of current under any circumstances. No attention need be given to the motor beyond the filling and cleaning of the oil cups.

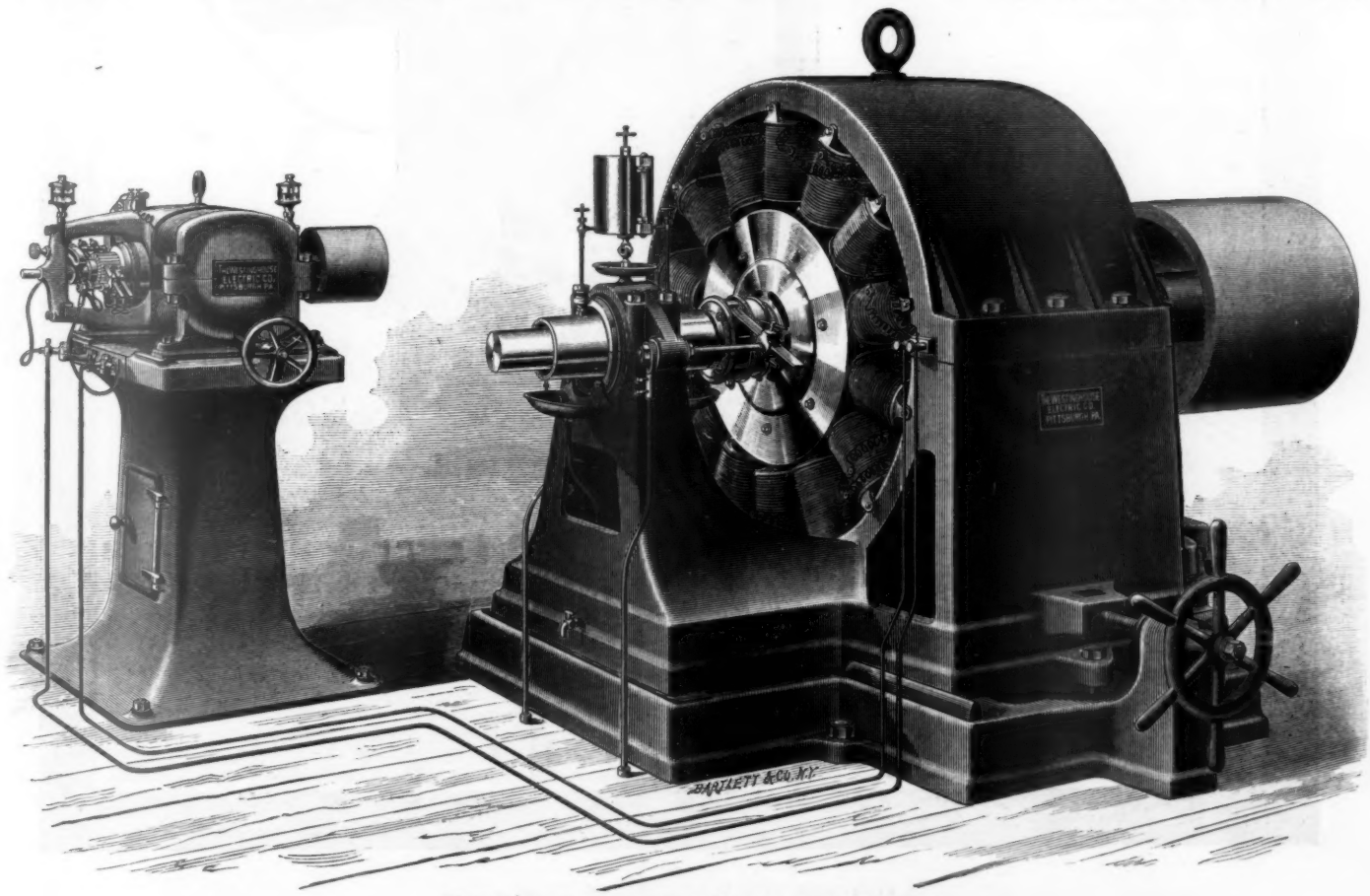
The alternating motor is more compact than the direct current motor, and lighter in proportion to the power delivered. It can be served either through a converter or directly from the primary circuits. The connections may be so protected that no inconvenience or danger can possibly result from direct connection to high tension service should such become desirable. As there are no sliding contacts, and the binding posts need never be touched or even exposed in any way, the use of a high tension current becomes possible. The extreme simplicity of the winding and general construction of this motor makes it very unlikely to get out of repair. The insulation of the armature is of no importance, since the current traversing it is never but a few volts and often less than one volt, regardless of the voltage of the supplying circuits. Absolutely no electrical knowledge is required in its operation, and the connections to the circuit in erecting are so simple that any one of ordinary intelligence can make them with ease and certainty. The alternating current motor is therefore thoroughly practical for manufacturing, commercial and domestic use in the hands of servants.

Our readers are familiar with the construction and details of the salient features of the system, such as the alternating current dynamo exciter and the converter, and we herein illustrate these various parts in their latest development, without further detail or description. Every feature has been designed with great skill indeed

The generators are made in four sizes of a capacity respectively of 500, 750, 1,500 and 3,000 lamps of 16 candles each. The converters are also in four sizes, 10, 20, 30 and 40 amperes in the secondary or low tension circuit, enough for 14, 28, 42 and 56 lamps. The general aim is to do as much distributing as possible with the primary and make the secondary short. The converters are placed on the line poles or on the outer wall of the building, the latter preferred. For very long distance work, a



THE FACTORIES OF THE WESTINGHOUSE ELECTRIC COMPANY, PITTSBURGH, PA.



WESTINGHOUSE ALTERNATING DYNAMO WITH EXCITER.

converter at the station raises the standard E. M. F. to 2,000 volts, and the ordinary line converters are connected at the consumption points, two and two, their primaries in series and secondaries in multiple. The "compensator" is a most ingenious satellite of the alternating system, serving the purpose of the extra "pressure-wire" of direct current systems, to enable the dynamo tender to preserve a constant drop of potential. The ammeters connected through the switchboard by short-circuiting plugs, show the volume of current on the mains. The "ground detector" is an interesting example of careful designing, and is very prompt and reliable. A standard voltmeter forms a very desirable part of every station equipment, and is so constructed as to be constant in its readings. By it the service voltmeters are calibrated.

The station switchboard is a beautiful sample of compactness. The figure shows one arranged for two exciters, two dynamos and four lines. Two exciter rheostats with changing switches have an obvious use, as also two dynamo field rheostats with coupling switch between. Four pairs of trunk lines, and two ammeters, by means of the changing switches can be used rapidly, and plugged out instantly. All the devices are guarded by safety catches. Four voltmeters and compensators are arranged for instant connection with the respective wires with two multiple-arcing switches, and six changing switches render any service connection possible in an instant.

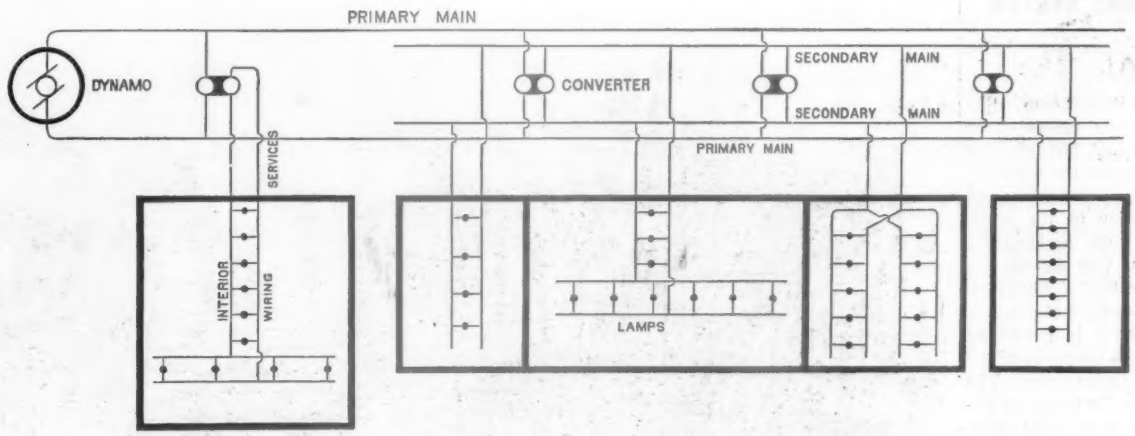
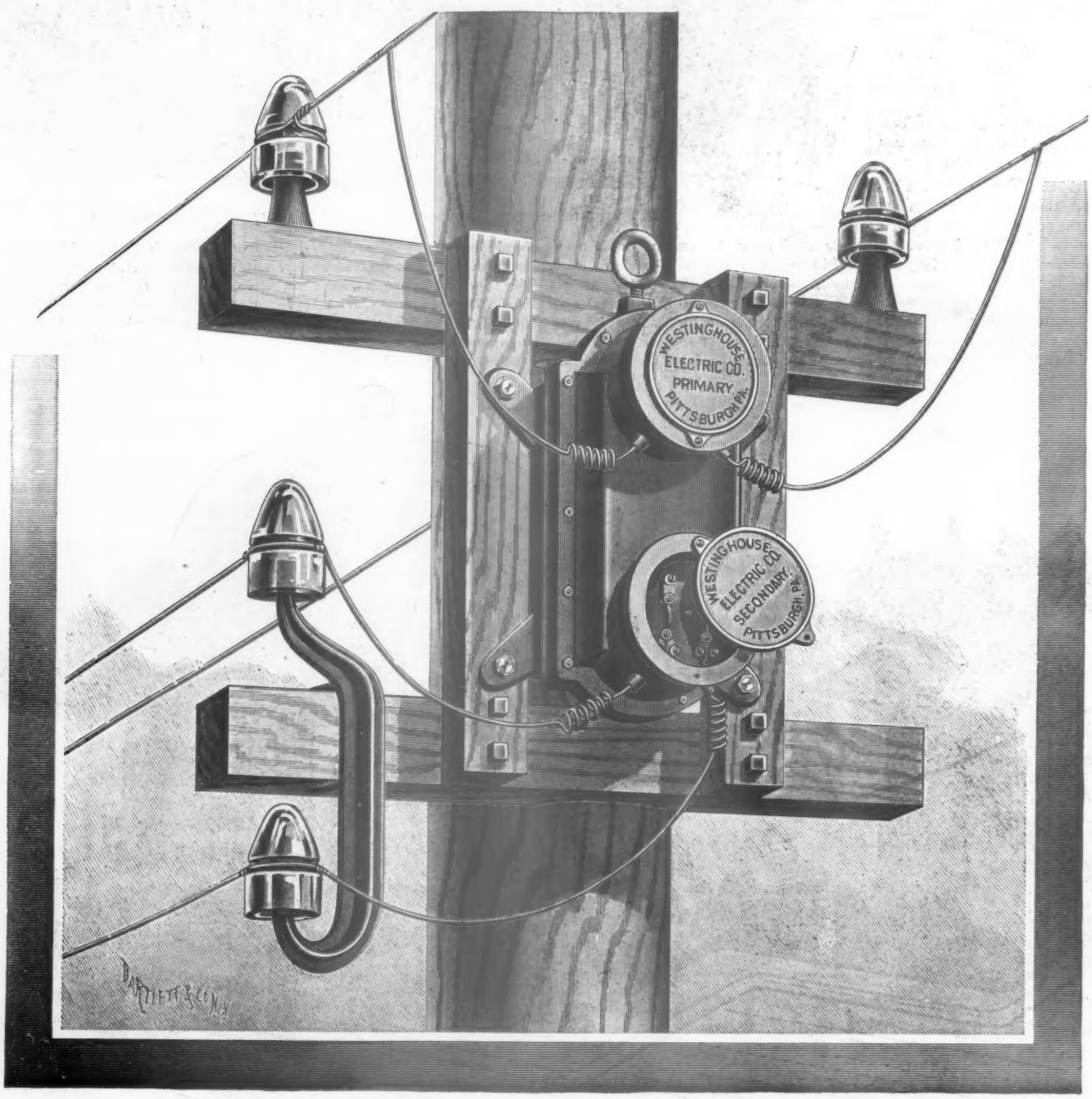
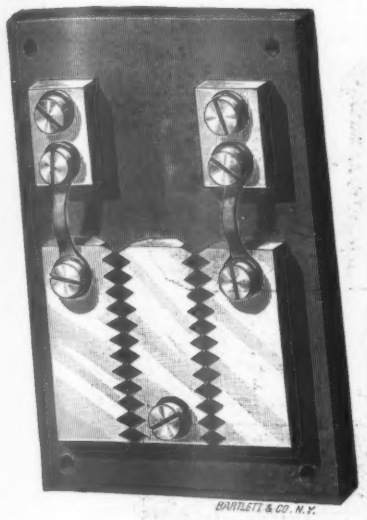


DIAGRAM ILLUSTRATING RELATION OF CONVERTERS TO DYNAMO AND LAMPS.



CONVERTER WITH DIRECT SERVICE WIRES.

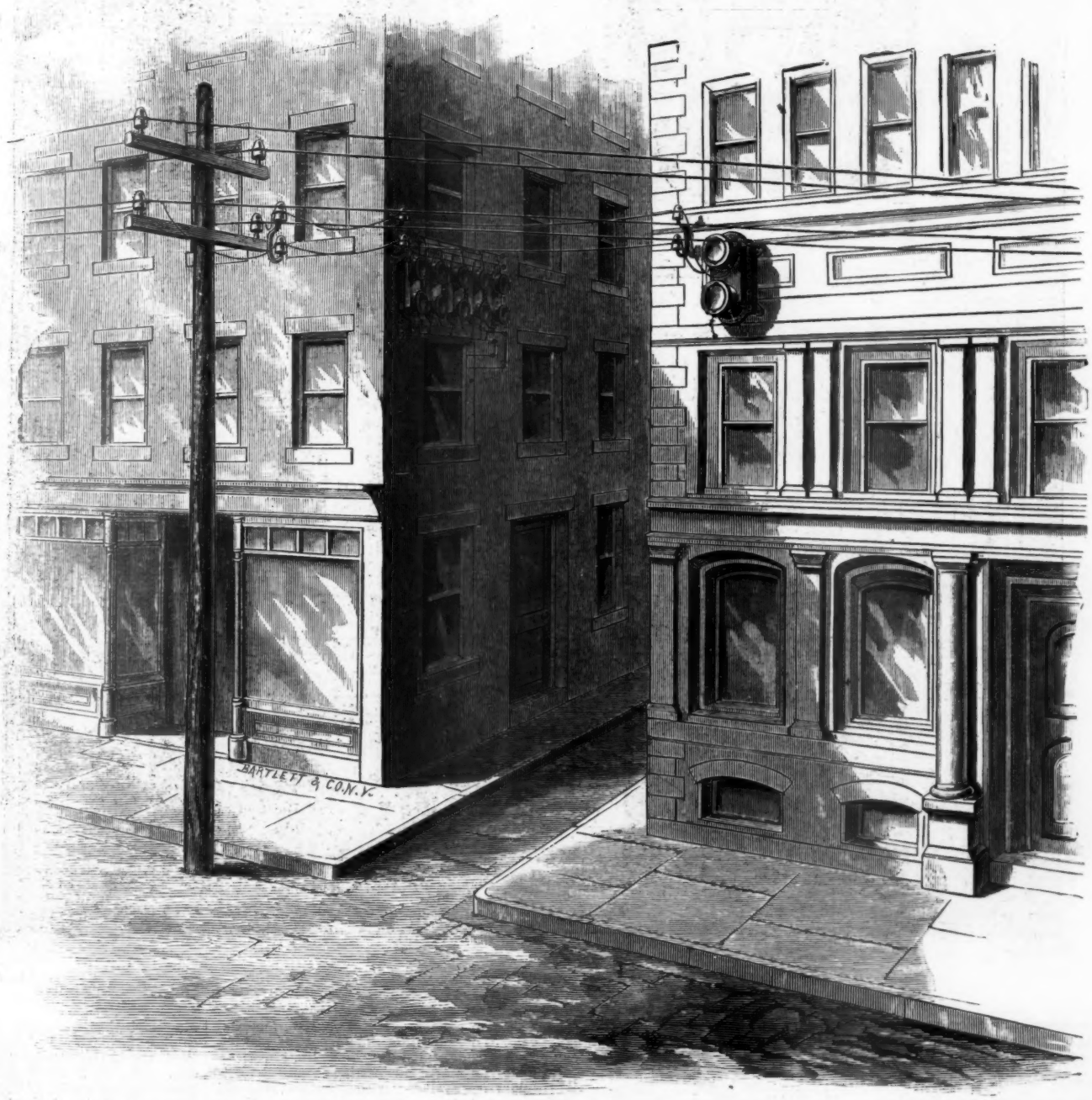
The "stage regulator" admirably illustrates the readiness with which the principles of induction lend themselves to the various purposes of hand regulation and control of



LIGHTNING ARRESTER.

current. The simple movement, in or out, of the rod, raises or lowers the brilliancy of the lamps as required. The "house regulator" serves a similar purpose, but is based on

COMPENSATOR.



CONVERTERS ON BUILDING.

somewhat different principles. The convolutions of the converter are adjustable in their number and, the amount of induction thus readily governed.

The alternating current meter is especially deserving of praise. By it a shaft is rotated at a speed proportional to the square of the current, but this is offset to a simple proportion by a fan-wheel, and a certain speed of revolution counts off the ampere hours regularly. The consumer can, therefore, check his own meter readily.

The system, at least in the keen refinements necessary to fit the means to the end, and largely in the conception and designing of the devices themselves, is the work of Mr. O. B. Shallenberger, and the Westinghouse Company is to be congratulated on the possession of an electrician who, while yet young and vigorous, has such judgment and capacity.

The Middlesex Electric Light Co., Lowell, pays a semi-annual dividend of 3 per cent.

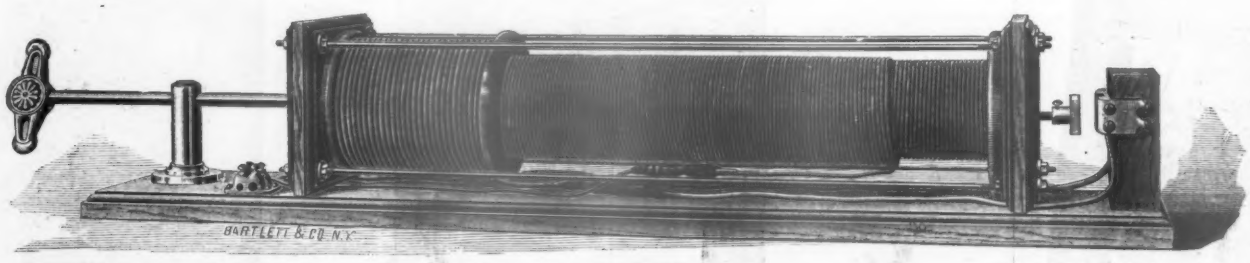
Additional New Corporations.

East St. Louis, Ill.—The Cutting Electric Alarm Company of St. Louis; capital, $8,000; for the manufacture of alarm appliances. Incorporators W. H. Cutting, B. C. Graham and B. Gratz.

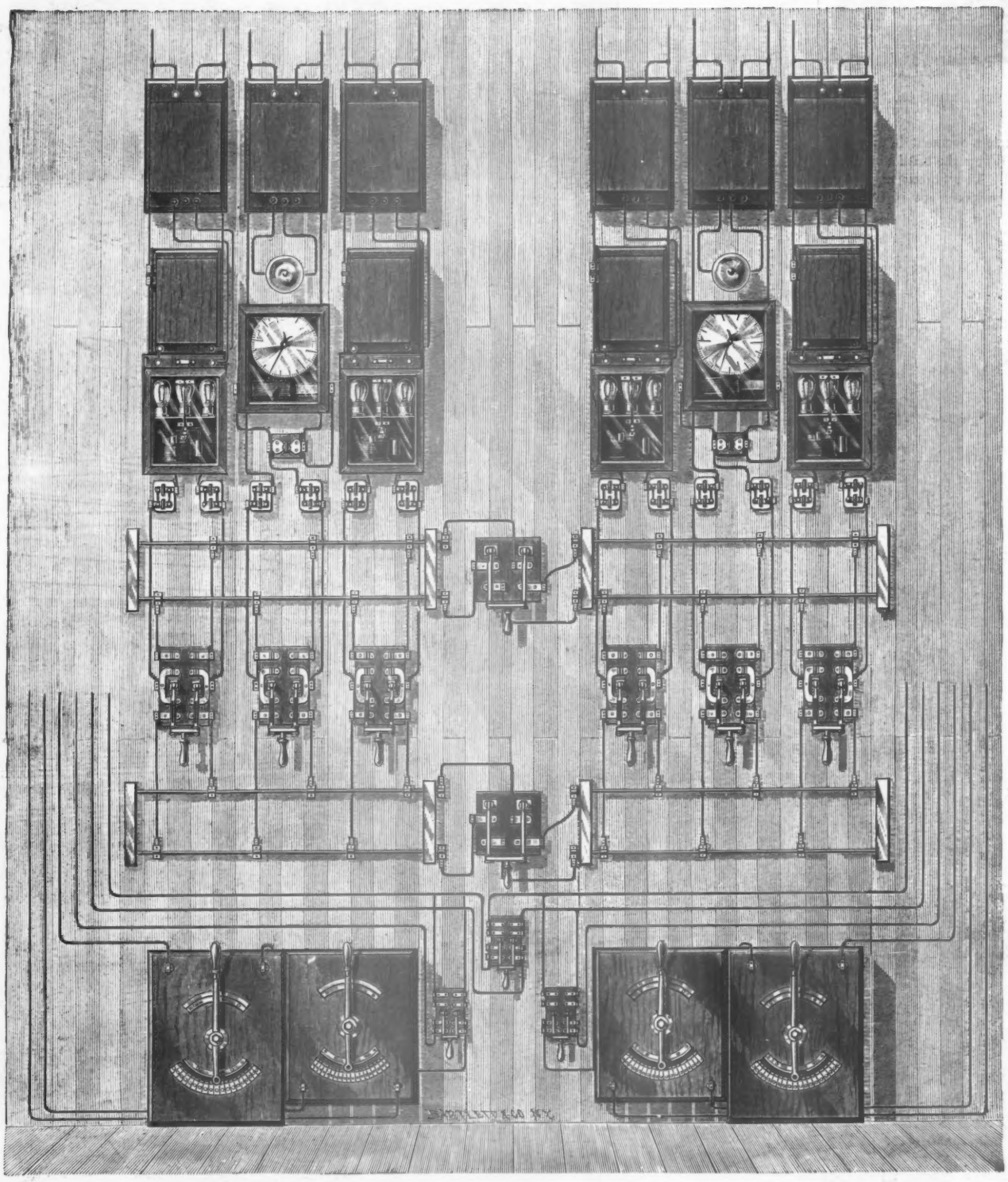
Detroit, Mich.—The Yoe Manufacturing Co. is organized for the purpose of making, purchasing and selling iron, tin, brass, copper, forgings and castings, with $15,000 paid up capital. Alexander McVittie, Edmund J. Owen, Robert J. McCarty, Henry Yoe and Frank E. Kirby are incorporators.

Chicago, Ill.—The Northwestern Railway Car Signal Company of Chicago; capital, $500,000; for the manufacture of car signals. Incorporators C. P. Larned, R. T. Brewer and C. C. N. Reeve.

Eau Claire, Wis.—The National Electric Manufacturing Company of Eau Claire; capital, $50,000. Incorporators Ralph E. Rust, David Drummond and Henry N. Hayden. Also the Beloit Bathing Cabinet Company; capital stock, $8,000. Incorporators Traton W. Wallis, John C. McIntosh, Thos. and Henry E. Wallis.



STAGE REGULATOR.



THE WESTINGHOUSE SWITCHBOARD.

Manufacturing Notes.

The price of platinum has gone up about 12½ per cent. in Europe. As the price there governs largely the quotations here, it is fair to presume that platinum dealers of the United States are now engaged in marking up their goods, thereby increasing their wealth, all of which will have to be expended when next they purchase their stock.

The Ball Engine Company, of Erie, Pa., is represented in New York City by Messrs. Chas. R. Vincent & Co., No. 15 Cortlandt street.

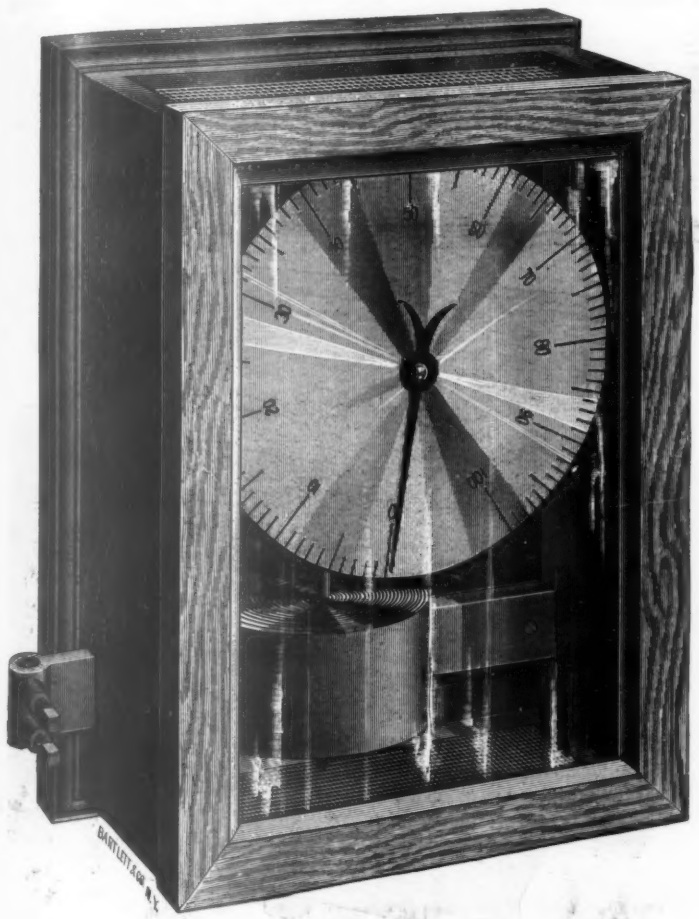
Messrs. Williams & Potter, the wide-awake representatives of the "Straight Line" engine, have moved into offices at 15 Cortlandt street. They are crowded with orders, and have every reason to be pleased with the outlook in the electrical field.

The Phœnix Glass Company is meeting with great success in supplying not only the every day demand, but in satisfying the artistic element that is daily growing and spreading in the incandescent lighting field. Their latest designs of globes are very attractive.

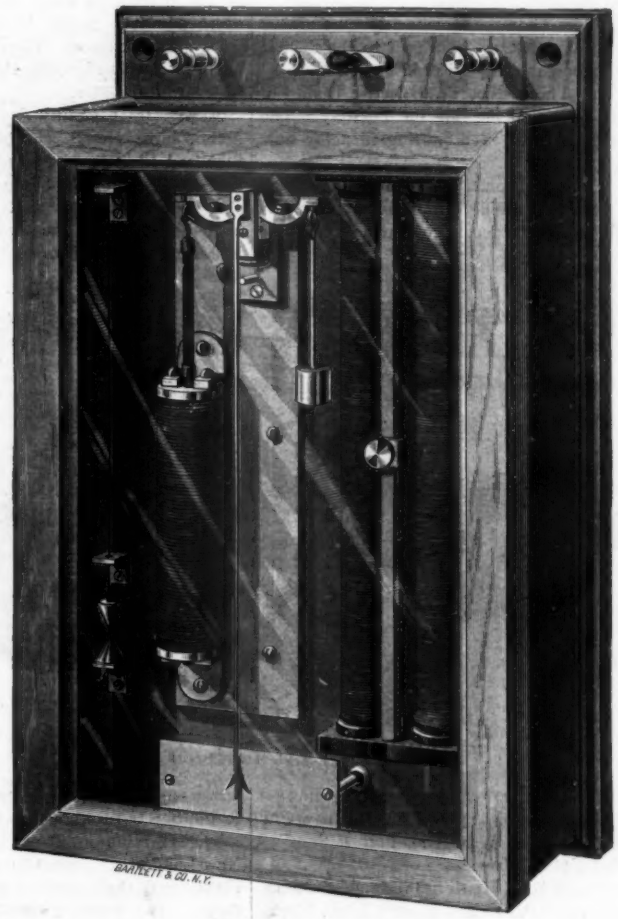
The American Leather Link Belt Co., 46 and 48 Ferry street, New York, report recent sales of their belting to the following concerns for use on dynamos: Standard Light & Power Co., Montpelier, Vt.; Travers Bros., 556 W. 52d street, New York City; Edison Elec. Ill. Co., Boston, Mass.; Burlington Gas Light Co., Burlington, Vt.

The Jarvis Engineering Company, No. 61 Oliver street, Boston, have recently received orders from the following concerns to set their new boilers with the Jarvis Patent Furnace:

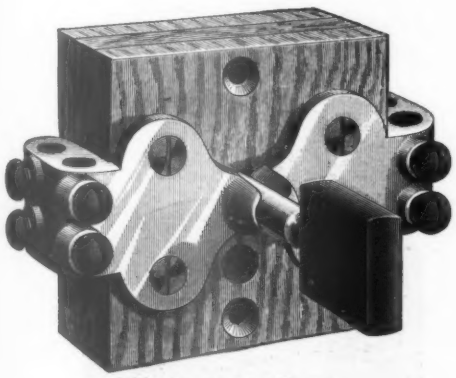
Athol Electric Light Co., Athol, Mass., one boiler Louisville Electric Light Co., Louisville, Ky., three boilers. Bath Electric Light & Power Co., Bath, Me., one boiler. C. F. Hessler & Sons, Reading, Penn., one boiler. N. T. Hill, Portland, Me., one boiler. Blackinton Woolen Co., Blackinton, Mass., one boiler. Hyde Park Electric Light Co., Hyde Park, Mass., one boiler. Augusta Brewing Co., Augusta, Ga., two boilers. Girad Wrench Manufacturing Co., Girad, Penn., one boiler. J D. Thomas, Knowlesville, N. Y, one boiler. A. W. Brodie, Hespeler, Ont., three boilers Auburn Electric Light Co., Auburn, N. Y., two boilers. Reading Steam Heat & Power Co., Reading, Penn., four boilers. Charles L. Van Reed, Reading, Penn., four boilers. Beebe Estate, Boston, Mass., two boilers.



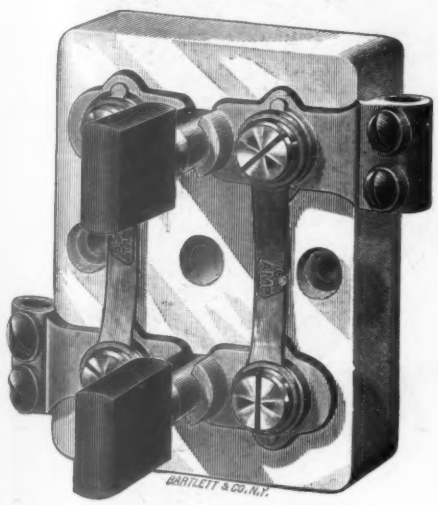
AMMETER.



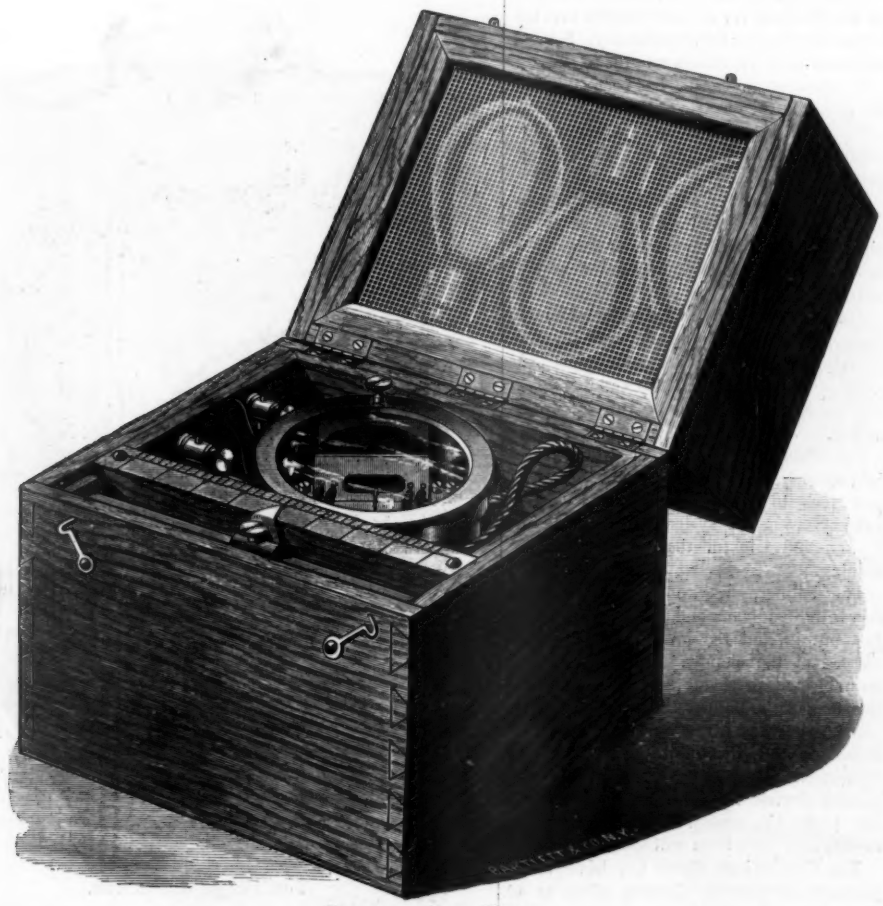
STANDARD VOLT METER.



SHORT CIRCUITING PLUG.



SAFETY CATCH HOLDER.



PORTABLE VOLT METER.

New England Notes.

South Weymouth, Mass., is to have electric lights.

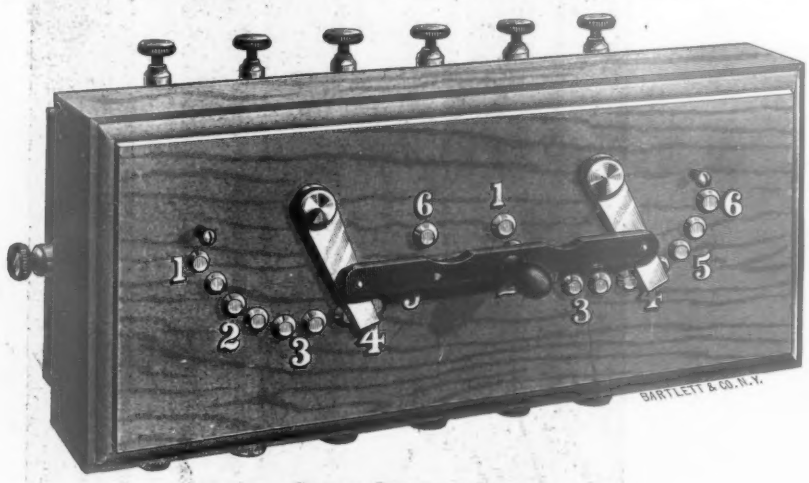
East Boston is being supplied with the Wilson police signal system.

The Franklin, Mass., streets are to be lighted with an increased number of arc and incandescent lamps.

A new Thomson-Houston dynamo of 500 lights capacity has been sent to the electric light company, of Milford, Mass.

The Thomaston, Ct., Electric Light Co. held its annual meeting on Tuesday. The company have been putting in many new lights of late.

A 2 horse power Sprague motor is used in a Boston bathing establishment for operating a peculiar mechanical arrangement for giving massage.



GROUND DETECTOR SWITCH.

A 50 horse power Armington & Sims engine is to furnish power for the new 400-light plant of Wm. Knowlton & Sons, of West Upton, Mass.

Senator Z. C. Keith has resigned the management of the Edison Electric Light Works at Brockton, and Supt. H. G. Balkam has been made manager instead.

A stir is being made in the city of Boston by the demands for an investigation into the cost of the electric lights to the city. Several contracts have yet fifteen months to run.

A second steam engine has been added to the power at the electric light station, Montpelier, Vt., the company being determined to furnish the list of lights regardless of expense.

Peabody, Mass, is agitating the question of municipal electric lighting. The example of the neighboring town of Danvers is used as an argument in favor of such a course.

Treasurer Twitchell, of the Bath Electric Light and Power Company, says that the electric lights about to be introduced at Augusta at $75 a year, are 1,200 candle-power, and the machinery is to be run by water-power.

The Cambridge Alderman accepted an invitation from the Thomson-Houston Co., last week, to inspect the overhead electric railway using its system at Washington, D. C., and left for that city on Friday evening.

The Palmer, Mass., union passenger station is lighted by arc and incandescent lights just put in, and the local paper is much pleased at the change. J. S. Holden has been elected president and Chas. B. Fish, treasurer of the Palmer Electric Co.

A hearing was given by the gas commissioners on the petition of the Newton and Watertown Gas Company for authority to furnish electric lights. The Newton Electric Light Co. present a strong case as remonstrants. Decision will soon be reached.

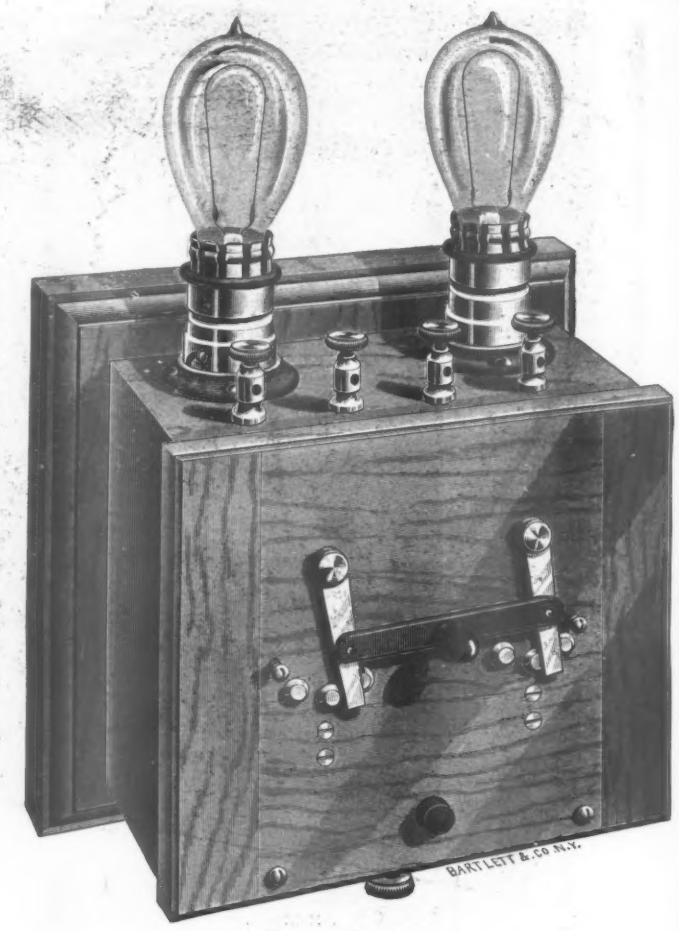
The Connecticut Motor Co. have taken pleasant and centrally located offices at 42 Union Place, Hartford, and are putting upon the market their own line of motors from ½ to 5 horse power. Their motors are of pleasing design and combine efficiency with great compactness.

A test is being carried on at the Massachusetts Institute of Technology with an eight horse power automatic motor of the "C. & C." make. It is designed to be used for driving a small circular saw which a prominent surgeon contemplates using in the Massachusetts General Hospital.

The Boston *Record* is carrying on a crusade against over-head wires, the cry being "Bury the Wires." The immediate cause of the proceeding was a recent fire where overhead wires greatly interfered with the work of the firemen. The city government has appointed an investigating committee to look into the matter.

Messrs. Isaac Prouty & Co., Worcester, Mass., have closed a contract with the Standard Electric Light Company for putting electric light plant into their boot and shoe shops at an early day. The apparatus is to be placed in the new engine house building, and, of course, their 250 horse-power engine will furnish the requisite power in addition to running the other machinery.

The Huntington Street Baptist Church, New London, Ct., recently repaired, is now illuminated throughout with incandescent lights. The work of installation has been very carefully done under the supervision of Mr. Arthur Paine, of the Oneco Works, of Willard Crane, president; Elias Lyman, vice-president; Robert Roberts, clerk and treasurer. The president, vice-president and Messrs. Edward Lyman, W. S. Vincent, E. A. Pope, C. C. Post and J. M. Mathews are the directors of the new corporation which is expected to begin business at once and push incandescent lighting.



GROUND DETECTOR.

THE HOUSE REGULATOR.

STREET LAMP COIL.

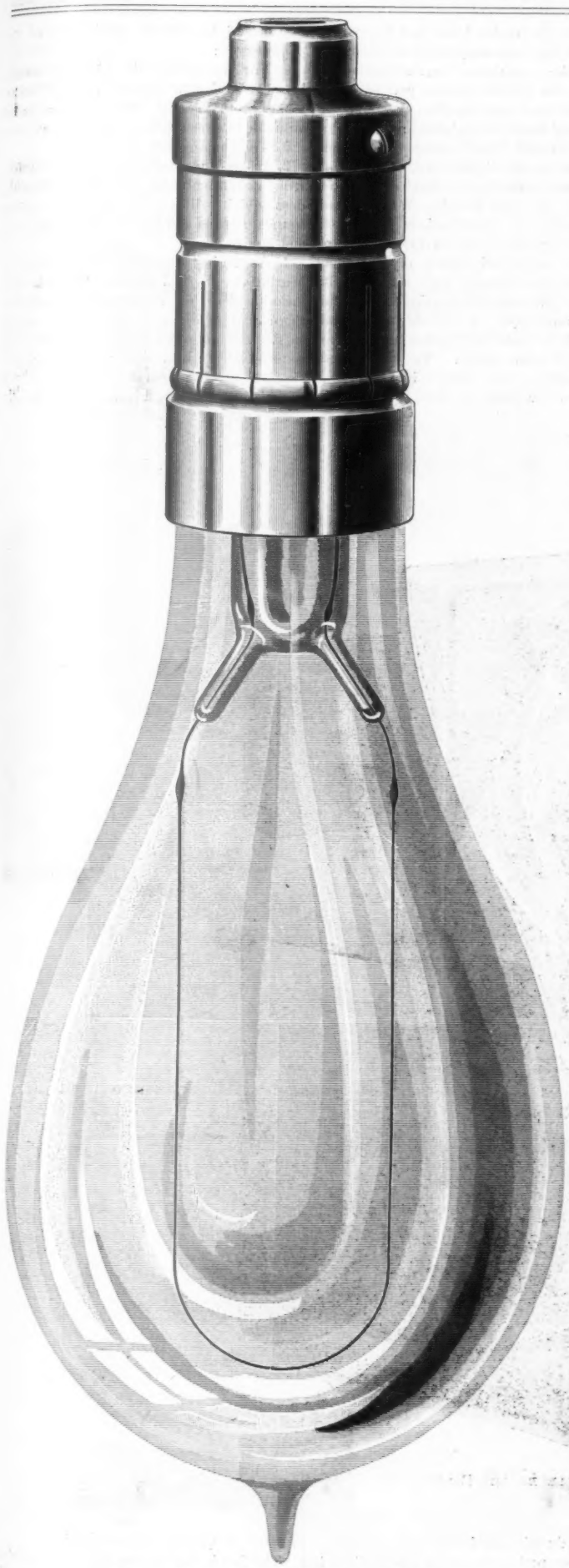
and the arrangement is tasteful and convenient. Other city churches will doubtless follow the lead of the Huntington street society when the advantages of the electrical illumination are seen.

The organization of the Citizens' Light and Power Co., of Burlington, Vt., was effected on Monday evening, by the election

The West End Street Railway Co. were given a hearing Thursday morning by the R. R. Commissioners on the application of the company for confirmation of the permission already granted by the aldermen to construct and operate electric roads in Boston and Brooklyn. Mr. Knight, of Bentley-Knight Conduit Co., whose system is to be used, was

present, and showed plans and mechanical drawings of the system. Vice-President Cummings and counsel Hyde did most of the talking, and president Whiting was also present. The matter was held for advisement.

The examiners of the New England Insurance Exchange held examinations at several out of town points last week. Messrs. G. F. Curtiss, W. L. Stevens and Edward Blake were in charge at Waterville, Me.; Messrs. E. L. Caldwell, Lovering and Pope at Springfield, Mass.; and W. S. Hill, Col. Hewins and Mr. Johnson at Rutland, Vt. The examinations were successfully carried on at these places, and the examiners were hospi-

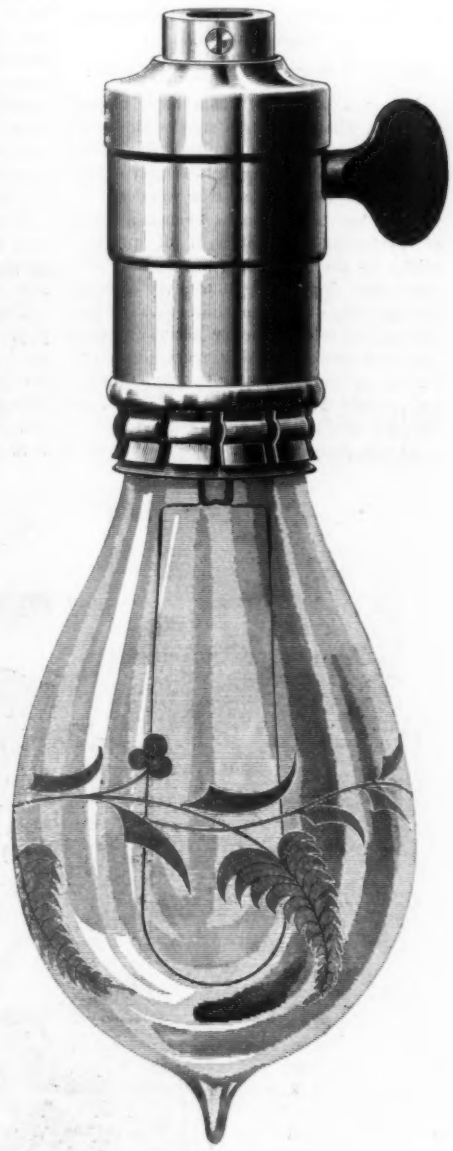


SPECIAL LAMP—50 AND 75 CANDLE POWER.

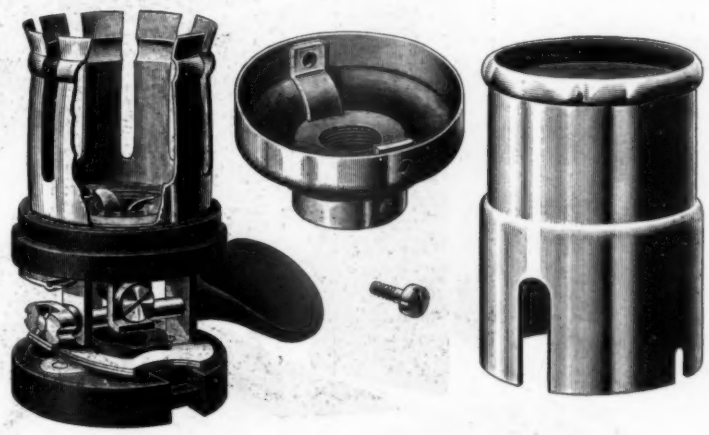
tally entertained by local managers. The Rutland delegation speak specially of the kindness of Mr. M. J. Francisco.

The Johnson mansion, West Lynn, has been started on the road for its site on Mall street, and as soon as possible after its removal, it having been divided into three sections for the purpose, excavations will be commenced for the foundation of the building to be erected by the Thomson Electric Welding Company. The building will be of brick 85 feet long with a width of 85 feet, and one story in height with a monitor roof. The apartments will be very lofty and with windows on the four sides and in the roof, the highest point for light will be obtained. The time to be spent in the erection of the building is limited to 60 days, which calls for a large gang of workmen. It is thought that the structure can be completed in that time or nearly so.

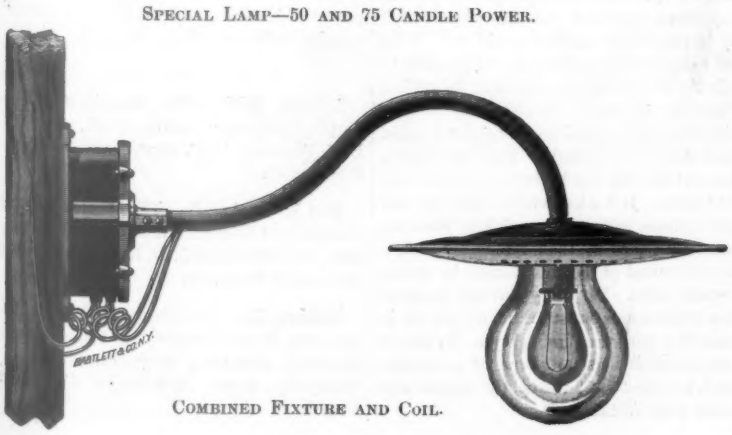
One of the most prosperous corporations of Woonsocket, R. I., is the Electric Machine and Power Co., organized in 1883. The company are doing a large lighting business throughout the city. They have at present five engines of 500 horse-power. Under a full head of water the water wheel has 250 horse-power. There are three 2,000 candle-power arc dynamos in daily service to run the street lights, and one in reserve. In addition to the street light dynamos there are three 1,200 candle-power arc dynamos to run the arc store lights, and five 400 light incandescent dynamos. The company has in service 79 street lights, the town paying for 77, the company maintaining two at their own expense, one on the top of their office and one on the Bernon street bridge. There are 79 commercial lights in use and 1,500 incandescent. Of electric motors there are 21, ranging from one-eighth to 15 horse-power. In addition to these there are twelve series lights on arc circuits, each of 65 candle-power. Levi C. Lincoln is general manager, Frank S. Pond, superintendent of electric department, and A. A. Jewell, chief engineer.



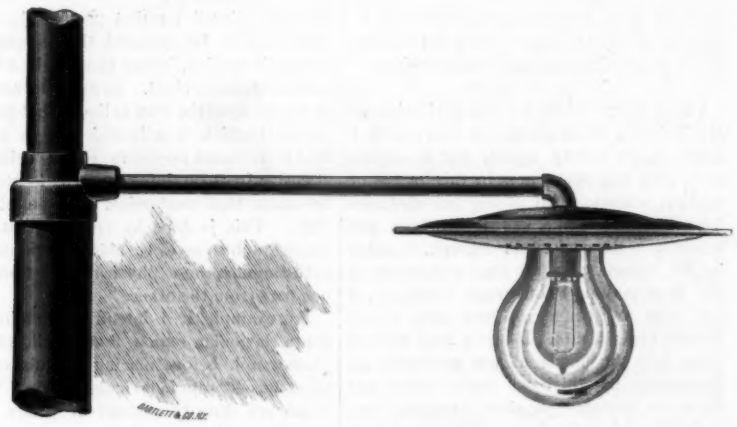
ENGRAVED LAMP.



DETAILS OF SOCKET.



COMBINED FIXTURE AND COIL.



STREET LAMP FIXTURE.

The Phonograph in Physical Diagnosis. Experiments.

BY DR. J. MOUNT BLEYER, NEW YORK.

Although some ten years have elapsed since Mr. Thomas Edison startled the world by inventing a machine that stored up sound and reproduced it at will, it is only within the past few months that this wonderful invention has been brought to such a degree of perfection as makes it of practical utility to the public at large. It is now some time since I began to investigate the practicability of this machine, so as to give the medical world a better means and more certain means of teaching, recording, reproducing and demonstrating the physical signs and sounds of the normal as well as of the diseased conditions of heart and lungs.

At this early stage of my experiments, I must say that I predict a great future for it, and the opening of a new field for investigation in physical diagnosis and teaching.

* * * * *

I have long waited for the perfection of Mr. Edison's phonograph, in order that I might again satisfy myself and re-experiment with this instrument in this branch of medical science. All of the old obstacles have been overcome, and it has been put before us as the perfect phonograph, so called by Mr. Edison. By the kind permission of the Metropolitan Phonograph Company, I was able to gain access and carry on my further experiments. It was a long wish to place into the hands of our profession an instrument by which we could record and teach our students physical diagnosis from the stages of our colleges. The sounds by this means can previously be stored up on these wax cylinders from patients that are at our disposal in the hospitals or from our private cases. Records of all physical diagnosis can be stored up and preserved for any length of time, so that one could illustrate from the old as well as from the new cases some interesting points of physical diagnosis at will, simply by replacing upon the steel coil the wax cylinder with its record.

From what observations I already practically made, I am satisfied that the phonograph has a great future and opens up a new field for our investigation.

The method which I adopted in making a physical diagnosis by the phonograph, was carried out in this manner. The phonograph was placed on a suitable table before me. The patient was undressed to the waist, a tube in the shape of the deaf conversation tube was then attached to the phonograph, the other end was placed on that part of the chest which was to be explored, the phonograph was set in motion, before placing the tube in contact with the chest. In order to register or record upon the wax cylinder that part of the chest which was intended to be examined it is found necessary either before or directly after examining any part to register by name that anatomical portion of the chest. This is done by speaking into the phonograph so as to be able in reproducing to distinguish those physical signs found in one part from the other.

For example, if I intend to examine the supra-clavicular region first, I talk into the phonograph before placing the tube on the chest thus—"supra-clavicular region." These words are directly registered. I now place the tube on that part of the chest and examine slowly and thoroughly and so I continued to explore the entire heart and lungs. It will be found necessary to allow the cylinder to make a number of revolutions before removing the tube to another part in order that more than one respiratory sound or heart sound might be registered and thereby gain a thorough idea between their pathological and normal significance.

The same method is also carried out upon examining the heart sounds. When I had finished with my examinations I returned back the reproducer, so as to repeat that which was registered during my examination. The phonograph was set hard in motion, a steloscope was applied to ears and to the phonograph. I was able to hear all the sounds in their varied pitch and tone as the sounds came along. The words and sentences that I had spoken into it for the purpose of recording the loud marks were all reproduced as perfectly.

These experiments have taught me how in many other ways and uses the phonograph may be practically applied to aid us. With some extra experimenting I will be able to apply the use of the phonograph in such a manner as to throw the physical sounds which have been previously registered upon one of these wax cylinders into the auditorium and thereby teach directly a large class of students. It is a known fact that one can learn a tone of a song quicker when he repeatedly hears it, than remember such a tone and sound as they are taught by means of words only. To carry out my purpose other attachments must be made use of in connection with the phonograph. I ordered a tin resounder in the shape of a trumpet which I expect will throw the reproduced sounds some distance off.

Some of the future applications of the phonograph:

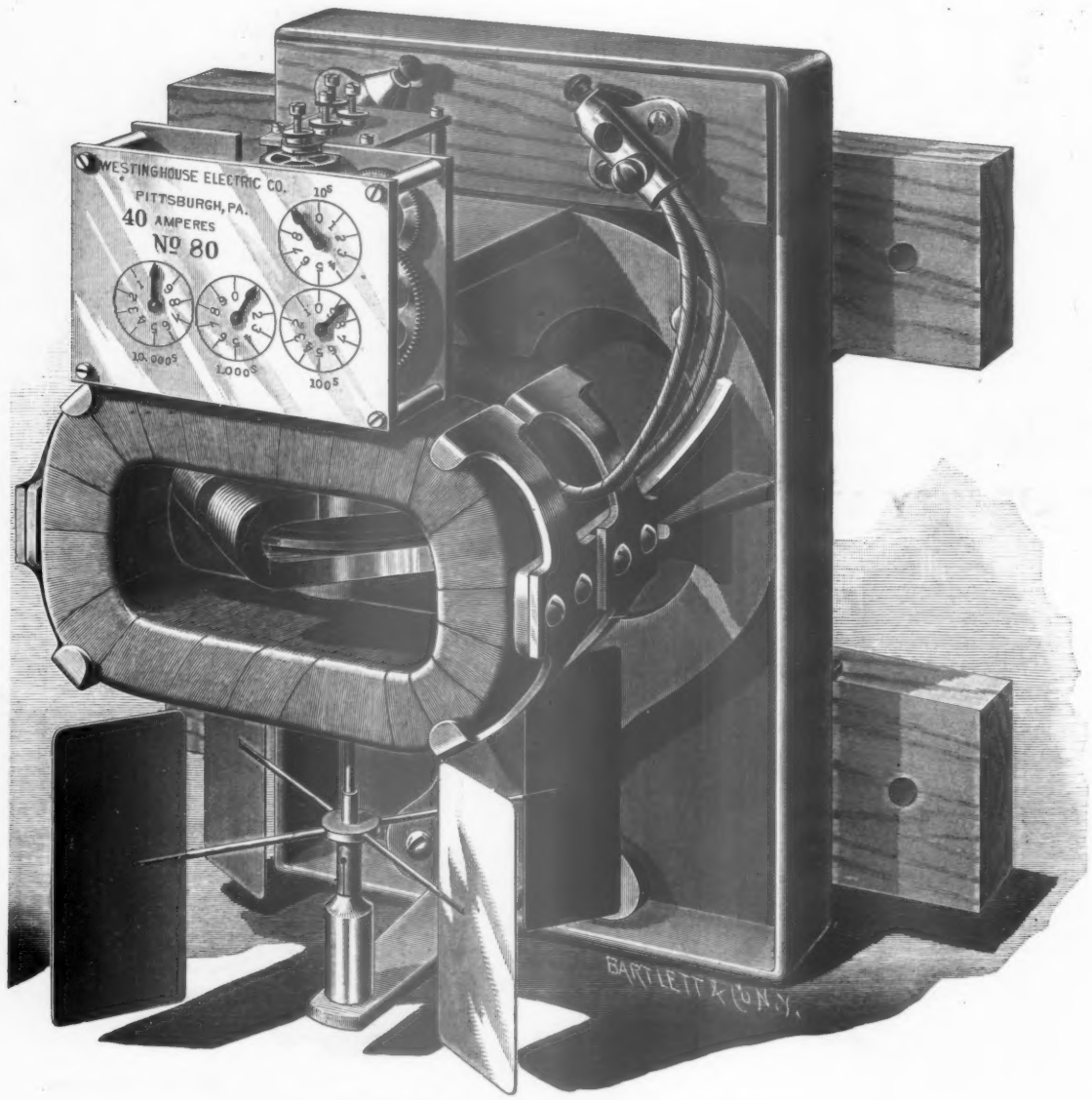
1. For recording the physical sounds heard from day to day and thereby able to make comparisons. This will be found valuable in consultations, etc.

2. To keep a record of cases.

3. Instead of studying physical sounds from a book, cabinets with registered cylinders which will contain all the physical sounds, normal and abnormal, of the heart and lungs.

4. As an instrument for the standard of hearing the physical sounds. To make this meaning clear, for instance, in consultation there often exists a controversy in regard to the different opinions of certain physical sounds that are heard by the different physicians, so if we can get an instrument which will always record the sounds alike no difference of opinion will be possible.

The fact is that all ears have not the same power of hearing and by this mode the main standard will have to be the phonograph.



ALTERNATING CURRENT METER—SHALLENBERGER PATENT.

Detroit, Mich.—The Michigan Phonograph Company; capital stock, $300,000. Levi Barbour, C. C. Bowen and others incorporators.

East St. Louis, Ill.—The Western Heater Company of East St. Louis; capital, $1,500,000. Incorporators J. D. Ryan, J. S. Dunne and James Hannerty.

Chicago, Ill.—The Pumpelly Storage Battery and Motor Company, at Chicago; capital stock, $300,000; incorporators James K. Pumpelly, Louis Mendelsohn and Abner Crossman.